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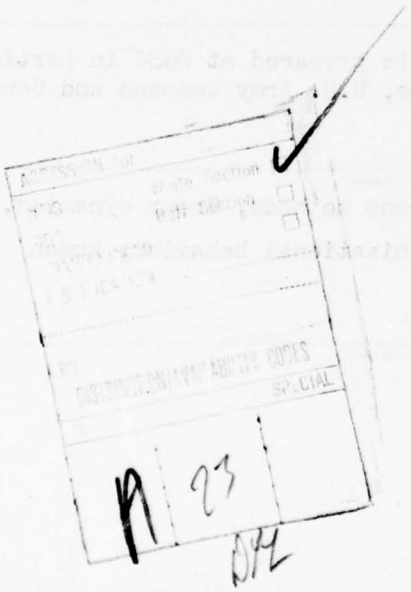
The ability to creatively solve problems is a critical skill for a military commander/manager. Creative problem-solving depends upon creative alternative generation or ideation. An often espoused method of improving ideation is the use of group brainstorming. However, the findings reported from numerous brainstorming experiments cast doubt on the efficacy of group participation in brainstorming. Nevertheless, criticisms of the experiments abound and the technique continues to be a popular, recommended management tool.

This pilot study compares the effectiveness of group brainstorming to individual brainstorming by contrasting the quantity and quality of ideas generated in a brainstorming group to the pooled ideas produced by an equal number of individuals working alone. The study reviews the major brainstorming experiments and attempts to directly address the major criticisms of those studies in the experimental design. The methodology maximizes the potential for effective group brainstorming within the constraint of practicality in a military setting in order to evaluate the technique and determine the desirability of a more comprehensive field study.

The findings clearly support the superiority of individual over group brainstorming using currently recommended techniques. Nevertheless, the study demonstrates that the potential usefulness of group brainstorming is not a dead issue and further study is warranted.



BRAINSTORMING TO INCREASE ALTERNATIVE GENERATION: A COMPARISON OF GROUP PARTICIPATION AND POOLED INDIVIDUAL EFFORT

A thesis presented to the Faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements for the degree

MASTER OF MILITARY ART AND SCIENCE

by

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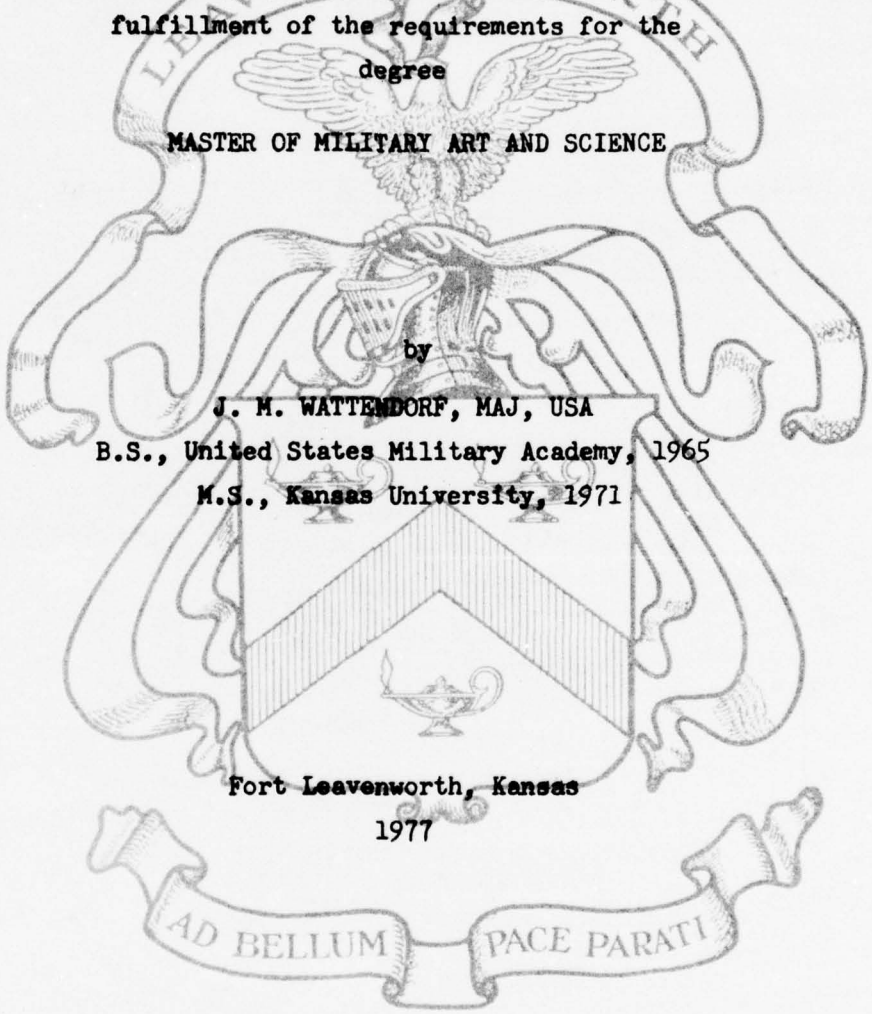

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Brainstorming to Increase Alternative Generation: A Comparison of Group Participation and Pooled Individual Effort

John M. Wattendorf, MAJ, USA
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Final report 10 June 1977

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The opinions and conclusions expressed herein are those of the individual student author and do not necessarily represent the views of either the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

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ABSTRACT

The ability to creatively solve problems is a critical skill for a military commander/manager. Creative problem-solving depends upon creative alternative generation or ideation. An often espoused method of improving ideation is the use of group brainstorming. However, the findings reported from numerous brainstorming experiments cast doubt on the efficacy of group participation in brainstorming. Nevertheless, criticisms of the experiments abound and the technique continues to be a popular, recommended management tool.

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The findings clearly support the superiority of individual over group brainstorming using currently recommended techniques. Nevertheless, the study demonstrates that the potential usefulness of group brainstorming is not a dead issue and further study is warranted.

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CHAPTER 1

INTRODUCTION AND PROBLEM DISCUSSION

Introduction

A military commander/manager must make decisions. In fact, in a very real sense, the essence of the role of commander/manager resides in the decision-making responsibility. Obviously there are many other facets of the job which are important, even critical to the successful fulfillment of the role; however, regardless of the degree of proficiency in these other arenas, if a commander/manager is unable to consistently produce quality decisions, failure is the inescapable consequence.

Decision-making implies a choice between or among alternatives, even if the choice is simply one of acting or doing nothing. In many situations, however, the decision-making process is far more complex with many possible alternatives to evaluate.

Since a decision is a choice among alternatives, it follows that the quality of the decision is dependent upon the ability of the decision-maker to choose the best alternative available. However, the best possible decision from among a group of unsatisfactory alternatives may result in a "quality" decision that still does not solve the problem that the decision addressed. In other words, a commander/manager must be a good problem-solver as well as a good decision-maker. If none of the alternative courses of action will adequately solve the problem, it does not matter how adept the decision-maker is at choosing

the best alternative, the problem will remain. Thus, the commander/manager is vitally interested in the generation of alternatives.

A commander/manager must develop a staff that is highly proficient at generating quality alternatives. While the quality of the alternative solution to a given problem will depend upon many factors such as the technical proficiency and personal experience of the individual problem-solver, for the purpose of this study, such background factors will be considered as given. The question then becomes, given a problem to be solved for which there is no single unambiguous solution and a staff to generate alternative solutions or ideas as to how the problem can be solved, what technique can the commander/manager utilize to optimize the ideation effort of his staff. Should he simply close the group in a room and tell the senior member present to provide a list of alternative solutions in a certain amount of time? Or perhaps more and better ideas will be created if the members work independently with the senior member (for example, the chief of staff) collecting and organizing the results for presentation to the decision-maker after the individual effort is complete.

One technique designed to foster ideation that has achieved great popularity is the technique of brainstorming. From its inception in 1939 in the conference rooms of Batten, Barton, Durstine and Osborn, one of the world's largest advertising agencies, the term "brainstorming" and at least a notion of the technique, spread throughout the country (Clark, 1958, p. 53). Today, the word "brainstorm" is no longer a slang expression; it is an accepted word in the English language, defined in the dictionary and incorporated into the working vocabulary of most educated adults in the United States. Unfortunately,

the full meaning of the word and a comprehensive understanding of the technique were not communicated and disseminated nearly as well as the term "brainstorming" itself. Perhaps of more practical interest, however, is the controversy surrounding the effectiveness of brainstorming.

In his book published in 1958 entitled Brainstorming, Charles Clark described brainstorming as "a brilliant counterattack on negative conference thinking" (p. 53). However, in the same year that Clark's book was being published, Professor Donald W. Taylor and two of his graduate students from Yale University published the results of their experimentation with brainstorming in an article in the Administrative Science Quarterly in which they stated, "it must be concluded that group participation when using brainstorming inhibits creative thinking" (Taylor, Berry & Block, 1958, p. 43). The results of the Taylor et al. study evoked considerable controversy among social scientists; however, the use of the term "brainstorming," and indeed the use of the technique, continued to grow. Despite the findings of Taylor and his associates, one would be hard pressed to find an educated adult in the United States today who is not at least familiar with the term "brainstorming."

If it did nothing else, the Taylor et al. experiment at least showed that the efficacy of group brainstorming is questionable. In the next chapter, the Taylor et al. study and some of the experiments that their study engendered will be reviewed in some detail. However, the interesting fact remains that brainstorming, and particularly group brainstorming, is still widely accepted as a useful technique for the facilitation of one step of the problem-solving process, that

of alternative generation. For example, the author of an article on brainstorming in the January-February 1976 issue of Army Logistician suggested that brainstorming is "an overlooked management tool" which the commander can "use in obtaining more information on which to base decisions" (Stoddart, 1976, pp. 15-16).

Since the generation of alternative solutions to problems or the creation of ideas that may help solve a problem is of such critical importance to a commander/manager, the controversy concerning the efficacy of group brainstorming is interesting to the military decision-maker not only as a theoretical, academic exercise, but also as a practical question concerning a potential management technique. The general question that this study will address is whether brainstorming is in fact an effective technique for improving the generation of alternatives or ideation in a group setting in the military.

Brainstorming - The Technique

Before discussing further the importance of this study to the military, it is necessary to develop a clear understanding of the meaning of the term "brainstorming." According to Webster's Third New International Dictionary, the verb "to brainstorm" means "to practice a conference technique by which a group attempts to find a solution for a specific problem by amassing all the ideas spontaneously contributed by its members." Most students of creative thinking do not restrict the use of the brainstorming technique to groups. For example, Charles Whiting clearly advocates the use of brainstorming by an individual when he suggests, "probably the greatest single thing that you can do to increase your ability to produce creative ideas is to

cultivate the habit of conducting a miniature brainstorming session with yourself each time you are faced with a problem" (Whiting, 1958, pp. 89-90).

In essence, brainstorming is a technique or set of rules to assist an individual or group in the creation of alternative solutions; it is a technique designed to foster ideation. This study is concerned with the value of the brainstorming technique as a facilitator of group ideation, not as a technique for improving individual ideation. In practical terms, the study focuses on the question of whether a commander/manager in the military should have his staff work together as a group or separately as individuals if he/she wants to maximize the number and quality of ideas generated.

Perhaps the best way to describe brainstorming is to describe Osborn's four basic rules that govern the brainstorming session. First, all ideas are accepted and recorded without criticism or judgement as to their quality. During group brainstorming sessions it is considered a key task for the discussion leader to make sure that one group member does not criticize any idea presented by another member.

Second, wild or "way out" ideas are not only accepted, they are actively encouraged. The leader must vigorously and enthusiastically encourage the group participants to vocalize virtually all of the ideas that come to mind no matter how silly they may seem at the moment. A seemingly trivial idea may foster a very different idea in the mind of another. If the brainstorming technique is to have any chance of success, the discussion leader must do everything within his power to help the other group members overcome their inhibitions to openly communicating their free associations.

Third, it must be understood that the objective of the session is the production of as many ideas (for example, alternative solutions to the stated problem) as possible. Quantity, not quality, is the stated goal. The assumption that, ceteris paribus, a greater number of "raw" ideas will produce a greater number of quality ideas is implicit in the brainstorming technique as proposed by Alex Osborn. In Osborn's words, "the greater the number of ideas, the more likelihood of winners" (Osborn, 1953, p. 301). This assumption will be addressed in detail in Chapter 2.

Fourth, in a group brainstorming session, participants are encouraged to build on or add to the ideas of others. Again, as in the admonishment against criticism, the leader plays a key role in encouraging group members to improve on another's suggestion and not to feel that this is in some way an infringement on another's rights. The members must be made to overcome the tendency to be afraid to "steal another person's thunder." While other principles or guidelines are often suggested to refine and improve the brainstorming technique, the four basic rules described above provide the foundation for brainstorming (Osborn, 1953, p. 301).

Military Application

If brainstorming does increase the quality, and in a sense the creativity, of the ideas generated by a group, the technique is obviously very valuable to the military. Assume for the moment that the advocates of brainstorming are correct in their assertions that brainstorming does improve the creative ability of a group (or an individual) to generate ideas or alternatives.

Consider the commander who has defined a specific problem that he must resolve. As a skilled manager, he is aware of many different problem-solving techniques that he can employ; however, virtually every problem-solving method includes the generation of alternatives as one of the necessary steps to be accomplished. There are very few problems which face the commander which do not require some choice among alternatives for their resolution. Since the final decision is wholly dependent upon the alternative chosen, the quality of the solution is directly related to the quality of the alternatives generated. If Hannibal had failed to consider the use of elephants, he might have failed to solve his problem - the crossing of the alps.

The military commander is particularly concerned with the need for creative solutions to problems that he must solve. While the need for creativity is by no means restricted to the battlefield environment, the consequences of a lack of creativity are certainly more immediately and forcefully made apparent on the battlefield. Consider the environment in which the United States Armed Forces may have to be committed. The lethality and intensity of warfare on the modern battlefield was clearly demonstrated in the 1973 Middle East War - the Yom Kippur War. If U. S. Forces are committed in such an environment, it is likely that our commanders will be outgunned and outmanned by an enemy with weapons systems at least as good as our own. As the new military "how-to-fight" manuals point out over and over again, the United States can no longer rely on a war of attrition, dependent upon our industrial might to eventually secure a victory. The lethality of the battlefield may make the first battle, the last battle. The commander's mission is clear. He must win the

first battle and all subsequent battles until the war is won, and he must win in the face of staggering odds against him. To have any chance of success in such an environment, the commander must outthink the enemy. He must be bold and decisive, and he must be innovative and creative.

Although the requirement is less dramatic, there can be little argument that the military problem-solver should seek creative solutions to problems in a peacetime environment as well as on the battlefield. Consider the use of lasers to practice trainfire. The general opinion was that a trainee could not learn to fire a rifle accurately unless practice is conducted with live ammunition so that the shock of the sound and recoil are experienced. Nevertheless, the "wild" idea to simulate firing with silent, recoilless and relatively inexpensive laser devices on the training rifles was tested anyway. The "wild" idea proved to be not so wild after all; in fact, it proved to be an effective and efficient means of conducting marksmanship training. It appears that trainees very quickly overcome the shock of the noise and recoil of live ammunition when they switch from training lasers to actual weapons.

Creativity is important, even vital, to the military commander or manager. An officer must learn effective techniques for improving the generation of alternatives or enhancing ideation as part of his education. Brainstorming is advocated by many as one of the best techniques that a manager can use for facilitating ideation. However, the nagging question persists: Is group brainstorming really effective, or is the technique in fact a detriment to the generation of creative ideas? Should a commander/manager call together his staff to brainstorm

a problem, or will he improve the probability of better alternatives if the staff members work alone? This study will attempt to provide some evidence to help answer these questions as they apply to a military setting.

The Problem

The purpose of this pilot study is to test the effectiveness of group brainstorming compared to pooled individual brainstorming in a setting that is reasonably attainable in a military environment and that simultaneously attempts to maximize the effectiveness of the technique in order to evaluate the design and to determine the desirability of a more comprehensive field study. The experiment must not be over designed, that is, it should not be a contrived situation that forces a positive evaluation of group brainstorming in one isolated, artificial setting. On the other hand, keeping the constraint of a realistically attainable situation in mind, the design should optimize the group brainstorming technique.

In order to optimize the conditions for group brainstorming, it is necessary to minimize the psychological discomfort of group members, the inhibitions, that accompanies group problem-solving sessions. As a minimum, the subjects involved in face-to-face interaction in a small group should know each other by name and have had some experience working together in a small group setting. Having had some experience working together as a group, the members are likely to be less inhibited than a group composed of strangers, and they are likely to devote more of their energies to the task of brainstorming rather than to the sociometric problems related to group development. Obviously, this is

not to say that all behavior will be task oriented, but rather that the group brainstorming effort is likely to be more effective in an ongoing group than in a group of strangers.

The requirement for subjects who were members of actual groups posed problems with respect to the strict definition of random selection of participants from the same population; these problems are addressed in chapters 3 and 5. However, for purposes of this pilot study, it was decided that in view of the findings reported in other brainstorming experiments, this study would be useful to the degree that the conditions favorable to group brainstorming are optimized under the constraint of practical, realistic attainability in a military setting. While it is hoped that the results of this experiment may be generalized to other similar situations, the primary purpose of this pilot study is to determine whether group brainstorming is a potentially useful management tool for the military commander that is worth the effort and expense of further study in a field setting.

The basic methodology of the Taylor et al. study consisted of a comparison of the number of ideas generated by "real" groups - groups of individuals who brainstormed problems in face-to-face interaction - to the number of ideas generated by "nominal" groups - groups in name only because the group members brainstormed the problems separately with the results of the group members then being pooled for comparison purposes as if they had worked together. This study will utilize a similar design concept. However, because the group structure and functioning are different from the Taylor et al. design, the "real" groups will be called "operational" groups in this experiment.

The advocates of brainstorming have argued that the experiments conducted to test the effectiveness of group brainstorming have failed to adhere to all of the guidelines established for an effective group brainstorming session. The major criticisms concern the size of the groups, the time allotted for alternative generation, and the structure of the group (Whiting, 1958). This study is designed to address each of these criticisms.

Summary

A military commander/manager is a problem-solver and a decision-maker. Since the generation of alternatives is an important step in any creative problem-solving technique, and since decision-making constitutes a choice among alternatives, a commander/manager must learn the most effective techniques for fostering the generation of alternatives.

Brainstorming is advocated by some students of group problem-solving as a powerful management tool for the generation of ideas or alternatives. If brainstorming is in fact a useful technique for improving ideation, it is a management tool that should be mastered by all military officers. However, some empirical evidence has been gathered that seriously questions the efficacy of the brainstorming technique when used in groups as compared to when it is used by individuals. In fact, results of experiments such as those conducted by Professor Donald W. Taylor and his associates suggest that group brainstorming may actually have an inhibiting effect on ideation. The purpose of this study is to determine if group brainstorming is a potentially useful technique for improving ideation in the military.

Chapter 2 is a review of the history of brainstorming, a

summary of some of the experiments that have been conducted to study the brainstorming technique with emphasis on those aspects of the studies and findings that relate to this thesis, and finally, a short review of some of the literature on small groups as it relates to the design of this experiment.

The methodology used for this study is presented in detail in Chapter 3. The discussion includes the setting, method, and verbatim instructions to the participants.

Chapter 4 provides a discussion of the statistical methods used to evaluate the data and an interpretation and analysis of the findings.

Chapter 5 concludes the study with a discussion of the significance of the findings, problems encountered, conclusions, and recommendations.

A copy of the master list, a list of all the alternative solutions to the experimental brainstorming problem generated during the brainstorming sessions, is included as Appendix A.

CHAPTER 2

HISTORICAL AND LITERATURE REVIEW

Brainstorming - The History

It would be pure speculation to estimate when the various elements of the technique of brainstorming were first used to attempt to improve a group's ability to create alternative solutions to some problem the group was trying to solve. However, it was not until 1939 in the offices of Batten, Barton, Durstine and Osborn that the technique was formalized by Alex Osborn and the term brainstorming was born (Osborn, 1953, p.297).

As a partner in one of the world's largest advertising agencies, Osborn was vitally interested in improving the capability of the members of his organization to generate new and creative ideas that could be translated into practical solutions to the challenges facing the advertising industry. It was obvious to Osborn that the traditional business conference was not an effective way to generate creative alternatives; in fact, the conference as usually conducted proved an effective inhibition to creativity. To counter the suppressive effects that the traditional conference had on ideation, Osborn synthesized the rules that he thought would foster the generation of creative ideas into a technique that became known as brainstorming (Clark, 1958).

Brainstorming soon spread throughout the advertising industry and into other business organizations. The technique captured the imagination of the American people to such an extent that the term became

a new word in the English language and the technique (albeit often only a crude imitation of the technique proposed by Osborn), became a widely practiced procedure for attempting to facilitate creativity in groups.

Brainstorming not only provided a useful alternative to the traditional business conference when ideation was a stated goal, but also apparently fostered an interest in group procedures devoted solely to the generation of creative ideas. One might argue whether the growth of interest in group ideation and brainstorming was a concomitant or epiphenomenal occurrence; however, the important fact remains that the formal recognition of the need for groups devoted solely to the task of generating ideas and the fact that such groups, in order to be successful, must operate in a different manner from traditional problem solving groups or committees gained widespread attention.

In 1947, General Eisenhower established an "Advanced Study Group" composed of officers tasked with the single mission of using their imaginations to envision future warfare. General Eisenhower clearly expressed his guidance to this unique group when he stated, "....this new group is divorced of all the practical and mundane things of today" (Osborn, 1948, p.267). The editor of the Army, Navy Journal at that time commented, "this is the only service unit in history that is solely an idea-thinking organization" (Osborn, 1953, p. 298).

Osborn gathered a wealth of information from practical experiences with brainstorming in industry to support his claim that "the quantitative results of joint ideation are beyond question" (Osborn, 1953, p.298). For example, Osborn, in his book Applied Imagination, reported,

A group of engineers from the Carborundum Company took

> a course in creativity and later put to test the productivity of group versus individual ideation. The problem selected was what additional use could be made of certain manufacturing equipment which was not being employed to capacity.
>
> Twenty engineers were divided into two groups. One section jointly applied creative thinking to the problem, while those in the other section individually thought up suggestions without benefit of group discussion. When scientifically assayed, the findings showed that the "brainstorming" method had produced 44 per cent more worthwhile ideas than the solo method. (Osborn, 1953, p.299).

From the standpoint of scientific research, the evidence supporting brainstorming left much to be desired; however, until the late 1950's it was the only evidence available and it captured the public imagination.

Since the spread of the popularity of the brainstorming technique was so dramatic, coupled with the fact that the supporting evidence, while plentiful, was nevertheless unscientific, it is perhaps surprising that social scientists did not show much interest in studying the technique until after the publication of Taylor, Berry and Block's findings in 1958.

The controversy concerning the value of the brainstorming technique as a method for fostering group ideation was born with the publication of the third volume of Administrative Science Quarterly in 1958 in which Professor Donald W. Taylor of Yale University reported the results of a controlled scientific experiment designed to study the effectiveness of group brainstorming. Professor Taylor with the assistance of two advanced graduate students in psychology, Paul C. Berry and Clifford H. Block, conducted the experiment under a contract with the Office of Naval Research "to determine whether brainstorming does, in fact, yield more results than individuals working by themselves" (Whiting, 1958, p.90). Taylor concluded that as

a result of his study, "to the extent that the results of the present experiment can be generalized, it must be concluded that group participation when using brainstorming inhibits creative thinking" (Taylor, 1958, p.43).

The work of Taylor, Berry and Block fostered numerous other experiments which will be discussed shortly; however, the body of evidence taken as a whole remains somewhat inconclusive. Either because of a critical lack of replication of the significant studies or because of criticism of some aspect of the studies, the proponents of group brainstorming continue to extol its virtues. There can be little doubt that brainstorming is still a very popular technique for attempting to foster group ideation.

Today, the need for the results of purely creative thinking in organizations is well recognized. Many organizations form groups or task forces whose sole function is creative ideation and, despite the controversy that surrounds the efficacy of group brainstorming, many of these groups still practice the techniques of group brainstorming essentially as developed by Osborn in 1939. Whether or not group brainstorming is proven to be an efficacious technique for fostering group ideation, the world owes a great debt of gratitude to Alex Osborn for his far reaching contribution to the development of man's ability to think creatively.

The Experiments

Before discussing the individual experiments concerning brainstorming, a few general comments are in order. The focus of this study is on the effectiveness of the brainstorming technique as it applies to group ideation in a military setting. Essentially the experiment will

be a statistical comparison of the mean number of ideas generated by five-man operational brainstorming groups with appointed discussion leaders/facilitators to the mean number of ideas generated by five-man nominal control groups. Even a cursory review of the brainstorming experiments will suggest many interesting, unanswered questions concerning the brainstorming technique. From an academic standpoint, numerous variables can be distinguished which can be isolated and tested as dependent variables to determine their effect on the outcome of a brainstorming session. The problem, the setting, the group structure, the group composition, the instructions, the time, the manner of recording ideas, and the manner of presenting ideas are all general areas that suggest specific variables that can be subtly or grossly varied and compared. For example, the effectiveness of two structures could be evaluated by comparing a leaderless group to a group with an appointed leader. A more subtle refinement might compare the effectiveness of an appointed leader from among a group of peers to a leader occupying a formal position of authority.

While experiments such as those described are both interesting and necessary, a more general question is of more practical value at this time. If a military commander/manager wants to generate the maximum number of alternative solutions to a problem, should he assemble his staff for a group brainstorming session, or will he get more ideas if the members attempt to generate alternatives by working alone? In order to attempt to answer this question, it is necessary to conduct the brainstorming session under the most favorable conditions possible in accordance with the findings reported in the relevant literature and within reasonable constraints of a military setting.

The following literature review is directed toward a determination of the most favorable conditions for a brainstorming session.

Taylor, Berry and Block. Because of the importance of the experiment conducted by Professor Donald W. Taylor and his associates, it is necessary to describe this experiment in some detail. The primary purpose of the experiment conducted by Taylor et al. was to answer the question, "Does group participation when using brainstorming facilitate or inhibit creative thinking?" (Taylor, Berry & Block, 1958). The basic methodology consisted of a comparison of the number of ideas generated by real and nominal groups using the brainstorming technique as developed by Osborn.

Professor Taylor selected 96 Yale undergraduates, who were students in a course in Psychology of Personnel Administration taught by Taylor, to serve as subjects for his experiment. The subjects were ultimately divided into 24 groups of four students per group. Twelve of these groups were identified as nominal groups; that is, groups that would function as groups in name only. The 48 students who worked on the problem individually were assigned to four-student nominal groups by random number selection. Thus, the nominal group members brainstormed the assigned problems while working alone; the ideas developed were then pooled with the ideas developed by the other members of that nominal group (the lists were screened for duplication so that no idea was counted twice for any one group). The remaining 12 groups were designated "real" groups and brainstormed the same problem in a group setting. According to the authors, "each real group included men who not only knew each other but who also had

worked together effectively in small-group discussion over a considerable period of time" (Taylor, Berry & Block, 1958, p. 27).

After extensive pretesting, three problems were selected to be brainstormed. The problems were described by Taylor et al. (1958) as follows:

> 1. Each year a great many American tourists go to visit Europe. But now suppose that our country wished to get many more European tourists to come to visit America during their vacations. What steps can you suggest that would get more European tourists to come to this country?
>
> 2. We don't think this is very likely to happen, but imagine for a moment what would happen if everyone born after 1960 had an extra thumb on each hand. This extra thumb will be built just as the present one is, but located on the other side of the hand. It faces inward, so that it can press against the fingers, just as the regular thumb does now. Here is a picture to help you see how it will be. (A line drawing of a hand with two thumbs was shown by the experimenter at this point in the reading of the problem and then left in full view on the table during the entire period of work on the problem.) Now the question is: What practical benefits or difficulties will arise when people start having this extra thumb?
>
> 3. Because of the rapidly increasing birth rate beginning in the 1940s, it is now clear that by 1970 public school enrollment will be very much greater than it is today. In fact, it has been estimated that if the student-teacher ratio were to be maintained at what it is today, 50 per cent of all individuals graduating from college would have to be induced to enter teaching. What different steps might be taken to insure that schools will continue to provide instruction at least equal in effectiveness to that now provided? (p. 28)

The three problems were brainstormed in the order presented above by each of the real groups and each of the individuals who would later comprise the nominal groups. All of the participants were given instructions concerning the brainstorming technique with particular emphasis on the four basic rules of brainstorming. The

problems were presented orally by the experimenter, the subjects did not have a written copy of the problem.

Each problem was brainstormed for a total of 12 minutes, whether by a real group or by an individual whose efforts would later be pooled with the results of the other members of his nominal group. The experimenters deemed the allotted time to be adequate because "for both individuals and groups, appreciable periods of silence appeared between responses near the end of the twelve minutes" (Taylor, Berry & Block, 1958, p. 30).

Each of the brainstorming sessions, for both real groups and individual subjects, was recorded on an Edison "Voicewriter." Written responses were not used because they were considered to be "slow and inaccurate" (Taylor, Berry & Block, 1958, p. 30). After the experiment was completed a typewritten master list of all of the responses was made for each problem. Care was taken to make sure that no two responses were essentially the same idea expressed in different ways. The master list also identified the group(s) making each particular response.

The results of the experiment conducted by Taylor et al. showed a statistically significant superiority of nominal groups over real groups with respect to the number of responses generated. In fact, the results of the Taylor et al. (1958) study showed that "the analysis of variance indicates that this superiority of nominal to real groups is significant at far beyond the .0001 level" (p. 34).

Taylor et al. also attempted to assess the originality and quality of the responses. Any idea that was suggested by only one of the 24 groups was defined as a unique idea. The performance of real and nominal groups was then compared to see which kind of group

generated more unique ideas. Again, the nominal groups were significantly superior to the real groups - this time at the .005 level (Taylor, Berry & Block, 1958, p. 35).

The Taylor study also found that, if an adjustment is made for the difference in the number of ideas generated by the real and nominal groups, the number of unique ideas generated by the two kinds of groups are not significantly different for either of the "practical" problems - the "Tourists" Problem or the "Teachers" Problem. In other words, if both nominal and real groups had generated the same mean total number of ideas, the mean number of unique ideas generated by each type of group would not be significantly different. On the other hand, it is important to remember that this study clearly suggests that nominal groups, in fact, do create significantly more ideas than real groups and significantly more unique ideas.

The "Thumbs" Problem did not yield the same results when the adjusted means were compared. In fact, in this one instance, an analysis of covariance showed the real groups were superior to the nominal groups at the .02 level (Taylor, Berry & Block, 1958, p. 36). This finding demonstrates that the nature of the problem to be brainstormed may have a bearing on the relative effectiveness of real or nominal groups. Again, it is important to remember that this analysis in effect concerns the relative percentage of unique ideas, not the total number of unique ideas.

While the "Thumbs" Problem is intellectually interesting, it is not particularly relevant to this thesis. The "Thumbs" Problem is strictly a fictitious problem which the subjects know has little or no relevance to any real situation. The two realistic, practical problems

are much more closely related to the kinds of problems a military commander/manager may have to solve.

The Taylor study attempted to assess the quality of the ideas by developing five-step rating scales to test the feasibility, effectiveness and generality of each response to the "Tourists" and "Teachers" Problems. The rating scales for the "Thumbs" Problem tested probability, significance and generality. For each problem, an analysis of variance clearly indicated that the quality of the responses as defined by Taylor et al. were significantly superior for the nominal over the real groups "well beyond the .0001 level" (p. 39).

As was the case in the analysis of the unique responses, the three quality measures were analyzed for each problem after adjusting for the difference in the gross number of ideas generated by real and nominal groups. The results showed,

> no significant differences remain between real and nominal groups on the three measures for either the Tourists or the Teachers Problem. After adjustment, however, the difference on the Thumbs Problem remains significant at the .03 level. (Taylor, Berry & Block, 1958, p. 41).

Thus, the results were similar with respect to the analyses of the unique responses for the "Tourists" and "Teachers" Problems, but just the opposite for the "Thumbs" Problem. Taylor et al. (1958) reported that, in the case of the "Thumbs" Problem, "there is a superiority of the nominal over the real groups on the three quality measures over and above that accounted for by a superiority in total number of responses" (p. 41).

The study conducted by Taylor, Berry and Block has been discussed in considerable detail because it represents the first real attempt to scientifically investigate the technique of group brain-

storming, and because, in a very real sense, it represents the foundation for this study. The following studies will be discussed very briefly with emphasis only on those aspects of the findings that relate to this thesis.

Meadow, Parnes and Reese. During the late 1950's a series of three experiments were conducted on the general subject of individual brainstorming. The first experiment demonstrated that subjects can improve their ideation in a creative problem solving situation by receiving training which emphasizes the brainstorming technique (Meadow & Parnes, 1959). The second experiment, again using subjects with training in brainstorming techniques, demonstrated that subjects instructed to use the brainstorming technique produced more good ideas than subjects directed to produce only good ideas (Meadow, Parnes & Reese, 1959).

The third study used subjects who were untrained in brainstorming to determine the effectiveness of brainstorming instructions compared to directions to produce only good ideas (Parnes & Meadow, 1959). The brainstorming instructions strongly emphasized the desire for quantity not quality and the requirement to stifle judgement or evaluation of the ideas generated. The nonbrainstorming instructions emphasized the generation of good ideas only. Again, the evaluation of the results concerned the number of good ideas generated. The findings were consistent with the previous studies, the subjects directed to use the brainstorming technique produced significantly more good ideas than the subjects who did not use brainstorming.

Because the assessment of what constitutes a "good" idea is

such a subjective judgement, it is worth the time to carefully review the methodology used by Parnes and Meadow (1959).

> The rater was instructed to evaluate each response by two separate criteria: (a) uniqueness - the degree to which the response deviated from the conventional use of the object, and (b) value - the degree to which the response was judged to have social, economic, aesthetic, or other usefulness. The uniqueness attribute was rated on a three-point scale; one point indicated little or no uniqueness, two points indicated moderate uniqueness, three points indicated marked uniqueness. Similarly, the value attribute was rated on the three-point scale of little or no value, moderate value, and marked value. For purposes of testing the hypotheses, these scores were combined into a two-point scale - "good" responses and "bad" responses. A response was scored as "good" if it represented a combined score of at least 5; i.e., it had to be at least moderately valuable and markedly unique, or moderately unique and markedly valuable. (p. 173)

Perhaps the most significant finding from these studies with respect to the question concerning the value of group brainstorming in the military is the fact that further evidence was accumulated that indicates "a positive correlation between quantity and quality of ideas" (Parnes & Meadow, 1959, p. 176). Brainstorming does not simply result in the generation of a greater quantity of ideas; the technique concomitantly yields a greater number of "good" ideas. The evidence also seems to refute the criticism that brainstorming creates more ideas than nonbrainstorming only because the additional ideas are low quality as a result of the emphasis on wild ideas with no judgement or evaluation.

In discussing the body of research on brainstorming, Morris Stein (1975) states,

> It is indeed surprising that experimenters, regardless of the results they obtain, seem to believe that subjects who have probably never before used brainstorming in a deliberate manner for creative problem-solving can be induced to do so with either a simple or even with a more elaborate instruction, and, if they are induced to so behave that the induction is "deep enough"

> so that the subjects, at the time of the experiment, can be regarded as good representatives of the creative problem-solving technique they presumably have used in the experiment. (p. 139)

The findings reported in the studies discussed above provide some evidence that addresses this criticism. The first study (Meadow & Parnes, 1959) showed that individuals do improve their ability to ideate in a creative problem-solving situation after receiving training which emphasizes brainstorming. The second study used subjects with formal training in brainstorming in an academic setting (Meadow, Parnes & Reese, 1959).

The third study is perhaps most interesting with respect to Stein's criticism in that the experiment directly addresses the question of whether subjects who are untrained in brainstorming can improve their ideation in a creative problem-solving situation by simply following one-time instructions on the brainstorming technique as compared to subjects who are given nonbrainstorming instructions. The findings clearly showed that the individuals given the brainstorming instructions produced more ideas and, based upon the quality criteria established by the authors, they produced significantly more good ideas (Parnes & Meadow, 1959). The findings indicated that the subjects do follow the brainstorming instructions to a sufficient degree to significantly alter their behavior as demonstrated by their performance.

Cohen, Whitmyre and Funk. The study conducted by Cohen et al. was designed to provide further evidence concerning the brainstorming technique with respect to "the kind of problem, kind of groups, and degree of training" (Cohen, Whitmyre & Funk, 1960, p. 319).

All of the subjects were hospital administrative or professional

personnel. The trained subjects were differentiated from the untrained subjects on the basis of those who had participated in a 10-hour creative thinking course compared to those who only participated in a single indoctrination session.

The kind of group was defined as nominal, cohesive or noncohesive. The nominal groups were pairs of subjects whose efforts were pooled after independently brainstorming the problems. The cohesive groups were formed by selecting pairs of subjects on the basis of a sociometric ranking based upon the subjects stated preference of brainstorming partners. The subjects rank ordered their preference for partners. The cohesive groups were composed of individuals who preferred each other within the top six of the group; the noncohesive groups were paired from the bottom six preferences.

A total of 48 subjects participated in the experiment, half of the subjects were "trained" and half were "untrained." Within these major groupings the subjects were then divided into four dyads defined as nominal groups, four dyads defined as cohesive groups and four dyads defined as noncohesive groups.

Each of the groups brainstormed three different problems for a total of 12 minutes per problem. Two of the problems were used in the Taylor et al. (1958) study - the Tourist and the Thumbs Problems. Both of these problems were defined as non-ego-involving because the subjects had no personal interest in the problem. The third problem (actually there was a fourth problem, but it was discarded because it was determined to be too difficult and subject to misinterpretation), called the "Discharge" Problem, was defined as ego-involving because it related to the subjects' work and the subjects rated it significantly

higher than the Tourist or Thumbs Problem with respect to the "importance to them of performing well" (Cohen, Whitmyre & Funk, 1960, p. 320).

Because of the poor correlation among the judges' ratings of quality, the quality of the responses was not evaluated. Analyses were performed with respect to the mean number of ideas generated and the mean number of unique ideas generated.

Cohen et al. (1960) summarized the results of their study as follows:

> (a) Only on the ego-involving problem were there significant differences among the groups and then only in number of unique ideas produced. The cohesive-trained groups were significantly better than all other groups. Even with untrained Ss, the cohesive groups did significantly better than the nominal groups. There was no significant difference between the trained and untrained noncohesive groups. (b) Sociometric choices for brainstorming partners were significantly related to the subjects' perceptions of skill. Tentative suggestions were made on the basis of these findings to guide formation of creative thinking groups. (p. 322)

While the size of the groups was obviously smaller than Osborn's recommendation, dyads as compared to groups of 5 to 10 participants, the authors report several interesting findings which influence this thesis. Perhaps most interesting is the concept of an ego-involving problem as defined by the authors. Since virtually any problem presented by a military commander/manager to a group he has assembled is likely to be ego-involving, the findings reported by Cohen et al. (1960) suggest that the concept of group brainstorming merits further study.

The comparison of cohesive and noncohesive groups is also interesting. It is certainly open to question as to whether the participants chose to work together because they "liked" each other or because they were correct in their perception of their preferred partner's brainstorming skill. It is possible that the nominal groups were less

effective than the cohesive groups because the cohesive group members were "ceteris Paribus" more skilled at ideation.

Dunnette, Campbell and Jaastad. The study conducted by Dunnette et al. (1963) was basically similar to the Taylor et al. (1958) study with two major modifica ons. The subjects were chosen from among a group of research scientists and advertising men instead of college undergraduates. And, the subjects participated as members of both nominal and real groups to "help to define the conditions for the optimal combination of group and individual effort mentioned by Osborn" (Dunnette, Campbell & Jaastad, 1963, p. 30).

The study used the same three problems that were used in the Taylor et al. study and, in addition, a fourth problem, entitled "People" Problem was added. The People Problem was also a non-ego-involving problem. Thus, as far as the kind of problem is concerned, the Dunnette et al. (1963) study offered no new information.

The question of time was addressed in the study and the authors stated:

> Subjects were allowed to spend 15 minutes on each of the problems; in every session, nearly all ideas and solutions had been expressed at the end of 10-12 minutes. The time limit did not in any instance result in cutting off a flow of ideas. (Dunnette, Campbell & Jaastad, 1963, p. 32)

The findings supported the results that were reported by Taylor et al. in 1958. Dunnette et al. (1963) also attempted to assess the quality of the responses with a procedure similar to that used in the Taylor et al. study and concluded:

> It is evident that individuals produce responses of quality equal to or greater than that of the ideas produced in groups. The evidence is clear-cut: brainstorming is most effective when undertaken by individuals working "alone" in an atmosphere free from the apparently inhibiting influences of group interaction. (p. 36)

The authors also tested the hypothesis "that group interaction would facilitate the output of advertising personnel and inhibit the output of research personnel" (Dunnette, Campbell & Jaastad, 1963, p. 34). The hypothesis was not sustained and Dunnette et al. (1963) concluded that, "apparently, the inhibiting influence of group participation cuts across the kinds of personal and occupational differences investigated in this study" (p. 34).

The authors did find that a group brainstorming session conducted prior to the individual brainstorming session did seem to enhance ideation. Both research personnel and advertising men produced more ideas in the individual brainstorming sessions when those sessions were preceded by group brainstorming than when the individual sessions were conducted first. However, in either sequence, the pooled individual effort was significantly superior to group brainstorming. Thus, Dunnette et al. (1963) concluded:

> The "best bet" for creative thinking in attacking problems seems, therefore, to be the pooled individual efforts of many people with perhaps an initial group session to serve simply as a warm up to their efforts. (p. 37)

Rotter and Portugal. The experiment conducted by Rotter and Portugal (1969) attempted to further clarify the combination of group and individual brainstorming that would result in the most prolific ideation.

The problems utilized were the Tourists and Teachers Problems (Rotter and Portugal referred to these as "Tourist" and "Education" Problems) developed by Taylor, Berry and Block (1958). A total of 128 undergraduates were used to form the 4-member real and nominal groups.

Four different experimental conditions were tested: individual,

group, individual then group, and group then individual. The two "pure" conditions, individual and group, allowed 16 minutes to brainstorm each problem. The two "mixed" conditions, individual then group and group then individual, allowed 8 minutes in one condition followed immediately by 8 minutes in the other condition. In all cases, the results were recorded by each of the individual members by writing down the ideas generated.

The results showed that pooled individual effort is superior to group effort in the generation of ideas in every case tested. The authors reported that "this holds true whether individual work precedes, follows, or is independent of group work" (Rotter & Portugal, 1969, p. 340).

In fact, the individual condition proved to be superior in ideation to either of the mixed conditions as well as the group condition. Rotter and Portugal (1969) suggested:

> Since each of the mixed conditions was divided into two equal parts - one group and the other individual - one may argue that the production of ideas is simply a function of the proportion of time spent in an individual situation. In other words, the mixed conditions were superior to the group condition not because they allowed a combination of different working conditions but because they contained a period of individual problem solving. (p. 340)

Bouchard. Thomas Bouchard reported the findings of two brainstorming experiments in the same year that Rotter and Portugal reported their findings, 1969. In his first experiment, Bouchard investigated the efficacy of sequentially combining group and individual brainstorming to determine if such combination is superior to individual brainstorming. The results were markedly different from those reported by Rotter and Portugal.

Bouchard (1969) used the same four problems that Dunnette et al. (1963) used in their experiment discussed earlier. The pure individual condition consisted of a total of 20 minutes of brainstorming per problem (two consecutive 10-minute sessions). The mixed group then individual condition consisted of a 10-minute session of group brainstorming followed by 10 minutes of individual effort. When brainstorming as an individual, the subjects wrote their ideas on paper; in the group seting, ideas were tape-recorded.

Because the samples used by Taylor et al. (1958) and Bouchard (1969) were considered to be essentially similar, three of the problems used by Bouchard were the same as the three Taylor et al. used, and both studies compared real groups to nominal groups, Bouchard was able to compare the responses his groups generated to those generated by the groups in the Taylor et al. study. Bouchard used the mean performance of his groups for the first 10 minutes of each session in order to have a comparable time.

The comparison was striking. For example, the real groups in the Taylor et al. (1958) study developed a mean total of 38.4 responses to the Tourists Problem (p. 34) compared to 35.3 responses for the real groups in the Bouchard (1969) study (p. 10). The nominal groups in the Taylor et al. (1958) study generated a mean total of 68.3 responses to the Tourists Problem (p. 34) compared to 39.3 responses for the nominal groups in the Bouchard (1969) study (p. 10). The results for the other problems were similar. The Bouchard study yielded similar results to the Taylor et al. study when real group responses were compared (remarkably similar considering the fact that the Taylor et al. experiment allowed 12 minutes for each brainstorming session compared to 10 minutes

in the Bouchard study - the Taylor groups produced a slightly higher mean total number of ideas in each case). However, Taylor et al.s' nominal groups produced significantly more responses than Bouchard's.

Bouchard suggested several reasons for the fact that his experiment failed to demonstrate a significant difference between real and nominal groups. The two minute difference in time, the fact that Bouchard provided a copy of the problem to each subject and Taylor et al. did not, a difference in introductory procedures and a difference in the way responses were recorded provide possible explanations.

Bouchard (1969) stated, "the most crucial procedural difference between the experiments seems to be that the individual Ss of the present experiment wrote their responses rather than verbalized them" (p. 10). Bouchard cited an experiment conducted by Horowitz and Newman (1964) to support his hypothesis.

Horowitz and Newman compared the number of written ideas produced by subjects to the number of spoken ideas produced in response to two similar topics. The findings showed that more ideas are produced in a given period of time when the ideas are spoken than when the ideas are written. The authors concluded:

> For ideas alone, spoken expression (allowed 2 minutes for exposition) is significantly more productive than written expression even after 6 minutes of exposition ($p = .05$). At the 10-minute interval the difference begins to favor written expression, but not significantly so, nor does it reach significance after 12 minutes. (pp. 643-644)

In concluding, Bouchard (1969) states that he is led "to believe that the findings of Taylor et al. (1958) are not contradicted; nevertheless, it should be noted that they may hold only under the special conditions where S verbalizes his responses aloud when working alone" (p. 11).

The findings reported by Rotter and Portugal (1969) may be evaluated in light of Bouchard's analysis. Remember that Rotter and Portugal had all subjects, in both the individual, group and combined conditions, record their ideas in writing. In all cases the pooled individual efforts were superior in production of ideas.

Keeping in mind the fact that the brainstorming sessions lasted 16 minutes in the Rotter and Portugal (1969) study compared to 12 minutes in the Taylor et al. (1958) study, it is still interesting to compare the results as they were compared with the Bouchard (1969) study.

Again using the Tourist Problem for comparison, the Taylor et al. (1958) study produced a mean total of 38.4 responses from the real groups (p. 34) while the Rotter and Portugal (1969) real groups produced an average of 37.0 responses (p. 340). (Rotter and Portugal used both male and female groups, this comparison uses the data generated for the male groups because the Taylor groups were composed of all male subjects). The results are remarkably similar considering the difference in time. Apparently the conclusion by Taylor et al. (1958) and later by Dunnette et al. (1963) that 12 minutes was sufficient time for the production of most of the ideas is supported. It may be that the extra 4 minutes allowed in the Rotter and Portugal study was sufficient time to overcome the inhibiting effects of being required to write the responses.

A comparison of the nominal groups is even more interesting. The nominal groups in the Taylor et al. (1958) study generated a mean total of 68.3 responses (p. 34); the nominal groups in the Rotter and Portugal (1969) study generated an average of 78.0 responses (p. 340). The responses in the Rotter and Portugal study were written; in the Taylor et al. study the responses were voice recorded. Since the

comparative time in the Bouchard (1969) study was only 10 minutes, the individuals in the Rotter and Portugal study had an additional six minutes in which to write down their ideas.

The following summarizes the comparison of the mean number of ideas produced for the Tourist Problem in the three studies compared above:

STUDY	RESPONSE	MINUTES	TYPE GROUP	MEAN NO. IDEAS
Taylor et al. (1958)	oral	12	nominal	68.3
Rotter and Portugal (1969)	written	16	nominal	78.0
Bouchard (1969)	written	10	nominal	39.3
Taylor et al. (1958)	oral	12	real	38.4
Rotter and Portugal (1969)	written	16	real	37.0
Bouchard (1969)	oral	10	real	35.3

Because of the differences in the three studies, conclusions based upon a comparison of the results must be made with extreme caution. Nevertheless, it appears as if nominal brainstorming groups will retain their relative superiority over real brainstorming groups under the conditions first proposed by Taylor, Berry and Block in 1958, even if the nominal group members must write their responses; however, the time, even if it is the same for both real and nominal groups, must be of sufficient duration so that ideas are not still flowing freely when the time limit is reached. It is possible that the time devoted to writing down ideas in the real group session is less critical than in the individual situation because the members of a group must devote part of their time to listening to others. It may be that the ideas are written during the "listening time" with minimal adverse effects.

Bouchard's (1969) second experiment compared the brainstorming technique to "critical group problem solving." He noted that subjects are likely to be concerned more about what they would say next or what the other person would think of what they said than about what the other person was actually saying. He further reasoned that such self-centered preoccupation would be more detrimental to brainstorming than to critical problem solving. In order to overcome this bias, Bouchard designed a feedback mechanism into his experiment. "Feedback consists of having Ss listen to a taping of their first 5 min. of performance on a problem, and then allowing them to continue to work on the same problem" (Bouchard, 1969, p. 12).

The experiment used the Thumbs and Education Problems. In this case, Bouchard used three different 4-member groups: real brainstorming, nominal brainstorming, and critical problem solving. In the feedback mode, the subjects worked for 5 minutes, listened to the tape for 5 minutes and then worked for an additional 10 minutes. In the nonfeedback mode, the subjects worked for 20 minutes without interruption.

Bouchard (1969) found that "there are no significant differences between the feedback and nonfeedback groups within any of the procedures" (p. 16). Even when the ideas generated during the last five minutes of the nonfeedback groups' working time were subtracted (in other words, each group had 15 minutes actual working time), the groups that did not receive feedback generated slightly more ideas than the groups that did receive feedback. Bouchard's analysis indicated that the only significant effect of feedback in this experiment was that it is a detriment to group critical problem solving.

This experiment essentially reinforced previous similar experi-

ments by showing that, under the cited conditions, pooled individual brainstorming effort is superior to both techniques involving group participation. Bouchard (1969) summarized his findings by stating,

> In conjunction with the experiments cited earlier, it seems fair to conclude that brainstorming is superior to critical problem solving both when responses are written and taped, but this superiority is rather small in size. (p.20)

Brilhart and Jochem. The study conducted by Brilhart and Jochem (1964) investigated the sequence in which problem solving steps were addressed by 5-member groups with a sixth participant assigned as discussion leader. Three patterns were evaluated. In Pattern A the group was led through a problem solving sequence in consonance with the brainstorming technique. The subjects generated as many alternative solutions (ideas) as possible before establishing the criteria by which ideas would later be evaluated. In Pattern B the evaluation criteria was established before ideation took place; however, the ideation phase did attempt to follow the rules of brainstorming. In Pattern C, the group attempted to find a "solution" immediately after being presented the problem; no intermediate steps were directed by the discussion leader.

The Tourist and Teacher Problems from Taylor et al. (1958) were used along with a new problem called the "Library" Problem. Since the Library Problem may have been of direct concern to the students involved in the experiment, it was probably an ego-involving problem as defined by Cohen et al. (1960). However, no attempt was made to establish ego-involvement, nor was any analysis of the individual problems reported in this study by Brilhart and Jochem.

This experiment introduced two major variations which were not a part of the previously reported studies. The groups had an assigned discussion leader other than the experimenter, although the leader did not participate in the problem solving per se. And, the ideas were written on a blackboard for all group members to see during the session. Since this experiment was concerned with the problem solving sequence in a group problem solving session, no comparison was made with nominal groups. All groups had a leader, and all groups used a blackboard to record ideas.

The findings supported the brainstorming technique. Both of the detailed patterns, Pattern A and Pattern B, resulted in a significantly greater number of ideas generated than Pattern C. It is clearly advantageous to separate the process of evaluation from the process of ideation. The authors also concluded:

> The advice given in the majority of current discussion textbooks and manuals to establish criteria before attempting to find solutions appears dubious at best and harmful at worst. Teaching a pattern based on speculation and casual observation apart from experimental investigation may have lowered both productivity and satisfaction in many conferences and dicussions. (Brilhart & Jochem, 1964, p. 179)

Bouchard and Hare. The purpose of the Bouchard and Hare (1970) experiment was to investigate the effect of group size on a comparison of real and nominal brainstorming groups. The 168 subjects (male undergraduates) were divided into nominal and real groups consisting of 5, 7 and 9 members each. Each group or individual was given 25 minutes to brainstorm the problem. The only problem used in this experiment was the Thumbs Problem.

An assessment of the quality of the ideas generated was considered superfluous. Bouchard and Hare (1970) stated,

> The dependent variable was the number of different ideas generated. Previous work (Bouchard, 1969) has shown that more sophisticated scoring is unnecessary, since all other scores that can be derived from this type of data correlate highly with total quantity. (p. 52)

As a result of the experiments he had reported earlier, Bouchard (1969) hypothesized that real groups might be expected to generate more ideas than nominal groups if the group size is increased. However, the results of the experiment conducted by Bouchard and Hare (1970) showed that, for the group sizes studied, the hypothesis is clearly disproved. In fact, the gap between nominal group performance (mean total number of different ideas generated) and real group performance widened significantly as the group size was increased. In other words, as the size of the group increased, the superiority of nominal groups over real groups became more and more significant. The authors concluded, "the trends are unmistakable and suggest that had previous Es used larger groups, their results would simply have been more strongly confirmed" (Bouchard & Hare, 1970, p. 53).

The time allowed for each brainstorming session appeared to be more than adequate. Many individuals ran out of ideas "long before their time ran out, and none of the groups felt that they had been cut off before substantially saying everything they wanted to" (Bouchard & Hare, 1970, p. 54). An experiment conducted by John P. Campbell supports the findings in the Bouchard and Hare study. Campbell (1968) states that "it is doubtful that time limitations could explain the inferiority of the group solution. A 2½-hr. period was set aside for the experimental session and no time limitations were imposed" (p. 209).

Bouchard and Hare suggested that the major problem in the real

group session may be in the inefficient utilization of the available time. There were significant pauses in the discussion and, perhaps even more dysfunctional, there was a tendency for some of the members to monopolize the time with nonutilitarian elaboration of their ideas. It also appears as if some group members are content to sit and listen as long as other members are willing to do the talking. Obviously, the ideas which may have been contributed by these less active participants are lost if they are not communicated.

Bouchard and Hare (1970) suggested that a way could be developed to overcome the inefficient utilization of time and poor distribution of participation in order that

> the pressure to perform in the group condition and the resultant behavior may mirror the performance of applied brainstorming groups more closely than the procedure used in current experimental studies. (p. 55)

Bouchard. In 1972, Thomas J. Bouchard, Jr. reported the results of two experiments dealing with brainstorming groups in which he had introduced a new procedural rule designed to overcome the inefficiencies in time and member participation suggested by Bouchard and Hare in the 1970 study.

The first experiment did not compare nominal to real groups and will not be discussed in this thesis. The second experiment was "designed to assess the influence of motivation and training on group and individual problem solving" (Bouchard, 1972, p. 329). The new procedural rule, which was used in both experiments, required each group member to contribute an idea in sequence. If a subject could not think of an idea during his turn, he would say "pass" and the next member would speak. The subjects "were also encouraged not to get bogged down in long discussions about trivial points" (Bouchard,

1972, p. 326).

These experiments were fairly complex with many different variables interacting. The results are not readily generalized and, for the most part, not germane to this thesis; however, the findings do provide sufficient evidence to suggest that Bouchard's sequencing procedure should be investigated further. Sequencing may even improve group brainstorming to the extent that the effectiveness gap between nominal and real groups may become insignificant.

Dillon, Graham and Aidells. This study attempted to use a brainstorming problem that the subjects would find stimulating "because of their genuine interest and concern about finding solutions" (Dillon, Graham & Aidells, 1972, pp. 487-488). The subjects were students from the University of California, Berkeley. The problem, presented shortly after the Cambodian invasion in 1970, asked the following question:

> Given the current situation of an escalation of the war and the widespread intense reactions across this country, what can you as an individual do to effect change, and what things would you change? (Dillon et al., 1972, p. 488)

Four-member real and nominal groups brainstormed the problem. Two other conditions were compared in this experiment. Half of the real and nominal groups observed a videotape depicting a highly efficient four-man brainstorming group working on a problem; the other subjects did not see the videotape. Next, half of the real and nominal groups that observed the videotape and half of the groups that did not were given a 10-minute practice session to write down ideas on the actual problem that would be brainstormed. After the practice session, the papers were collected and the actual 25-minute session began. Ideas generated during the practice session could be used again

in the actual session. The groups that were not given the practice session simply brainstormed the problem for 25 minutes.

When the eight cells were compared, Dillon et al. (1972) found that the results showed

> a general superiority of individual over group brainstorming. Across all conditions, individuals brainstorming alone generated more ideas than did individuals brainstorming in groups. Contrary to prediction, a videotape training session in which individuals and groups were given an example of a smoothly functioning, rapidly idea-generating brainstorming group inhibited performance. (p. 489)

The study also showed that, when not preceded by observation of the videotape, the practice session improved performance for both real and nominal groups; however, "there was a tendency for practice to facilitate individual brainstorming more than group brainstorming" (Dillon et al., 1972, p. 490). It is not clear whether the improvement is a function of the practice or simply a function of having more time to work on the problem since the practice session actually represented 10 additional minutes of problem-solving time.

While the Cohen et al. (1960) study suggested that group brainstorming may be facilitated by an ego-involving problem, the authors of this study reached the opposite conclusion. Dillon et al. (1972) stated,

> Observation of groups brainstorming on various kinds of problems leads us to believe that people find it much more difficult to adhere to the rules of brainstorming when they are dealing with problems that they are interested in and care about. Thus, the general superiority of individual over group brainstorming appears even more pronounced when the problem is real and when motivation is high. (p. 490)

Bouchard and Hare (1970) provide a very appropriate closing statement for this review of some of the brainstorming experiments when they state, "there is little doubt that the question of group

versus individual brainstorming requires more investigation" (p. 55).

Group Methods

Before discussing the specific groups that will be formed for this experiment, it will be useful to review some of the literature on group methods. Since even a severely capsulized summary of the small group literature would encompass volumes of material, it is obviously necessary to limit the scope of this review in some manner. Therefore, only that material which most directly relates to the kinds of things that a military commander/manager should keep in mind when forming small groups for the purpose of brainstorming a problem will be discussed.

Two of the primary ways organizations have attempted to cope with the requirement for increased information exchange among specialized groups is through the creation of task forces and teams (Galbraith, 1971). For the purpose of this thesis, a task force is defined as a temporary group formed for the explicit purpose of solving a given problem or class of problems, or for making a specific decision or class of decisions. Solving a problem does not necessarily include making a decision as to the best solution; the problem assigned to the task force may be the generation of as many alternative solutions as possible. Thus, an operational brainstorming group, such as one of the operational groups used to conduct this experiment, is an example of a task force as defined in this study. Teams are simply permanent task forces. Throughout this thesis, concepts which are applied to task forces will be considered to be equally valid when applied to teams, unless explicitly stated otherwise. In order to attempt to optimize group brainstorming, it is necessary to carefully consider the infor-

mation available concerning task force design.

In spite of the fact that task forces occupy a vital position in the Army today, relatively little is known about task force design. Two important bodies of social science research offer considerable insight into the problem of task force design - the set of research studies of authority structures in small groups and the body of experiments on communication networks in small groups. The purpose of the remainder of this chapter is to consider how the theories resulting from these studies can be utilized in the development of efficient task force design.

One typical form of task force is composed of a group of individuals who are each specialists in a different functional area. For example, a task force may be formed by a military commander when he calls his staff together to develop alternative solutions to some problem that requires an unusual or particularly creative solution. The group might consist of representatives from subordinate commands as well; for example, company commanders may meet with members of the battalion staff to brainstorm a problem. At higher level headquarters or at an installation, the task force composition may be much more complex and heterogeneous. The key point is that the commander/manager must be aware of these individual differences and the impact that they may have on the group.

If the task force is to be successful, the members must be able to communicate freely and effectively. The communication network which evolves in a group is largely a function of the authority structure; thus, the authority structure may be considered as the independent variable for the dependent variable communication network.

The status and authority structures which are imposed on the group when it is established or which evolve over time as the group interacts will have a direct effect on the form of the communication network and the content of the messages transmitted.

The famous body of experimentation on communication networks inspired by Bavelas and conducted and reported by Leavitt and others has provided some valuable insight into the effects of various kinds of communication nets on group problem-solving ability. The basic experiment was quite simple; five participants were given five different colored marbles with one color common to each. The problem was to identify the color of the common marble. Each of the subjects was isolated from the others and only written communications were allowed through specified communication channels. For the sake of simplicity, consider two of the many possible communication networks; the star (sometimes referred to as a wheel network) and the circle network. The star has one participant in a position of centrality who can communicate with all others, but others may communicate only with him. In the circle network each participant may communicate with the person on his right and left. The results, for this simple task in this highly restricted situation, were clear. As reported by Leavitt (1964), the differentiated, non-equalitarian networks like the star facilitate faster, more accurate solutions; while equalitarian networks like the circle provide greater satisfaction for members (pp. 228-241).

Later studies, in particular those of Christie, Luce and Macy, (cited in Pigors et al., 1969), revealed that equalitarian networks are more efficient for more complex problems. The task was complicated by introducing "noisy" marbles; marbles with colors which were not easily

described and, therefore, introduced ambiguity to the problem. Pigors, Myers and Malm (1969) observed that decentralized networks are more likely to accept a "bright new idea" and adapt to unusual situations than are more hierarchically differentiated networks (p. 39).

The experiments on communication networks were conducted in a highly artificial setting; consequently, great care must be taken when attempting to generalize the results to groups in a natural setting attempting to solve real problems. Nevertheless, practical decisions must be made concerning the structuring of task forces regardless of how little evidence is available on which to base these decisions. The evidence indicates that, ceteris paribus, a highly centralized communication network is best if the problem to be solved is well defined and relatively simple, and if the speed of solution is a more important criterion than morale of the participants. If the problem is complex and ill-defined, a more equalitarian communication network will be more efficient.

Consider the communication networks that might develop in a task force composed of company commanders - members who are relatively equal in status and authority. If the task force is created by assigning representatives without appointing a leader for the group, several factors must be evaluated in order to predict the communication network that will emerge. If the members of the task force perceive that they are equal in status and authority, a relatively decentralized, equalitarian communication network may be expected initially. However, if the task force continues to meet for some time, a more hierarchically structured network will evolve. Bales conducted a series of experiments in which he observed the emergence of leaders (defined

as those who most often initiate and receive communications) among an initially leaderless group of peers attempting to solve a problem. Bales found that a bifurcated leadership structure evolved; one member became the task leader, or idea man, and another emerged as the socio-emotional leader (Bales, 1970). Thus, the communications become less random and free, and more directed toward and initiated by the two central positions.

The process by which a differentiated power structure develops in an initially unstructured group is nicely explained by Blau's description of exchange theory (Blau, 1964, pp. 19-25). Blau argues that people will interact as long as the exchange is mutually rewarding. The situation often arises in which one person possesses a resource that another desires but can pay for only with his gratitude. "A resource is a property of an individual - a possession, an aspect of his behavior, or merely his presence - which enables him to affect the rewards and costs experienced by another person" (Secord & Backman, 1964, p. 274). For example, an individual may seek advice from another possessing superior knowledge. Blau predicts that, if the exchange is to continue over time, the person must pay for the assistance he gains with more than a token "thank you" in order for the exchange to remain mutually rewarding. The result is an emergence of a power differential between the two if the individual seeking assistance rewards the other by acknowledging the dependency relationship.

As Emerson (1962) postulated, the degree of power that an individual (A) holds over another person (B) is a function of B's dependency upon A and is directly proportional to the "motivational investment" of B in the resources manipulated by A, and inversely

proportional to the availability of these resources external to the A - B relationship (pp. 31-41). Tension is often a concomitant result of the exchange process because of the psychological cost incurred when one person is forced to acknowledge the superiority of another. The undesired consequence of this exchange process in a task force may be a decrease in the freedom of communications among group members and, hence, a thwarting of the unhindered exchange of information; such inhibitions among brainstorming group members are disastrous.

In the task force described above, the group was comprised of members who were initially relatively equal in status and authority. Very few human groups meet the criteria of equalitarian status structures. For example, in the mixed battalion staff and company commanders task force the representative from the G-4 may be most knowledgeable of the technology required to solve the problem, while the representatives from the companies may perceive their interests are most at issue and the representative from the G-3 may be the senior in rank. Even if the members are intentionally chosen to be equal in status, such as a task force composed of staff members of equal rank, there is likely to be a perceived status differentiation because of the possible differences in status among the various staff elements. The problem is most apparent between command and staff representatives or between functional and general staff representatives.

Strodtbeck, James and Hawkins studied a number of juries in experimental settings to determine the possible influence of status differentials which are normatively external to the task. In spite of the fact that jurors are normatively expected to act as equals toward one another, this research clearly indicates that status differ-

entials wholly external to the jury situation have a significant influence on group processes and interaction. For example, those jurors with relatively high status outside the jury situation tended to participate and to be selected as foreman more often than those of lower relative status (Strodtbeck, James & Hawkins, 1957, pp. 713-719).

In an organizational task force where there are no normative expectations that all members act as equals we can expect the influence of external status differentiation to be even greater. Lenski's description of the phenomenon he terms "status crystallization" (Lenski, 1954, pp. 405-513), and Homans' evaluation of the same concept which he calls "status congruence," (Homans, 1961), provide a useful insight into some of the effects of perceived status differentiation among members of a group. Persons tend to perceive their status relative to another as being generally consistent in related situations. Thus, a person of high status in the organization as a whole will expect to be accorded high status in the task setting regardless of attempts to create an equalitarian status structure in this specific situation. For example, if the G-3 is generally accorded the highest status among a staff, he is prone to experience low status crystallization (inconsistent status) if he is made a member of a brainstorming group where all members are defined as "equal." Therefore, the evidence seems to indicate that a member of an organizational task force who is accorded only equal status within a task force relative to other members who are comparatively lower in status in the larger organization will be dissatisfied with the existing structure and may be a disruptive influence to the smooth functioning of the group. In the case of a brainstorming group, low status crystallization may be critically

dysfunctional.

The existence of a status structure within a group will manifest itself through the communication network which develops and also in the content of the messages transmitted. Simon, Smithburg and Thompson (1950) empirically supported the general observation that communications between a superior and his subordinate usually take place more easily from the higher status person to the lower status person (p. 235). If the higher status person is also an evaluator of the lower status person, the constraint to free communication is even greater. The military system creates a particularly formidable barrier to free communication because of the critical importance of even a single evaluation (such as an officer efficiency report) to a military career. Guetzkow reports that an experiment conducted by Cohen demonstrated that subordinates are less likely to express criticism to superiors who are also their evaluators than to those who exhibit no control over their advancement (Guetzkow, 1965, p.555).

The obvious danger of status differentials in a task force is that the members of relatively lower status may be psychologically restrained from fully participating in the problem solving effort, particularly if that effort involves the generation of ideas using the brainstorming technique. This dilemma is not a new or startling revelation to military commanders/managers as evidenced by the increased emphasis in the last two decades on training sessions aimed at opening communications within the organization. Guetzkow also reported a study conducted by Habbe which provides evidence to show that barriers to communication which are created by hierarchical structures may be overcome if sufficient effort is expended toward achieving that goal

(Guetzkow, 1965, p. 549).

In an experiment conducted by Collaros and Anderson, the findings showed that the presence of even one individual who is perceived as an expert by the other members is sufficient to significantly reduce the number of ideas generated by a brainstorming group. The authors concluded:

> Overall the results of the study indicate that social factors inherent in unequal status structures within the group are detrimental to member creativity even though brainstorming instructions are given. Group members feel threatened and inhibited by the presence of more knowledgeable members, consequently, the less expert members contribute few of their ideas and suggestions (Collaros & Anderson, 1969, p. 163).

If a military commander/manager wants to optimize the performance of a brainstorming group, he must be aware of the potentially dysfunctional aspects of perceived differences in status among group members and he must actively work at minimizing their effects.

Thus far only task forces without an established formal authority structure have been examined; however, in many instances a task force leader may be appointed by someone in a position of higher authority relative to the group members. At this point it is useful to consider a fairly precise definition of authority and use it to distinguish between the concepts of endorsed and authorized power. Scott defines authority simply as "legitimate power" where "legitimacy has to do with the existence of a set of social norms that defines situations or behaviors as correct or appropriate" (Scott, 1970, p. 385). If the norms are developed and enforced by persons subordinate to the "power wielder," the authority is referred to as endorsed power; if they are developed by superordinates, the authority is termed authorized power (Scott, 1970, pp. 386-387).

The appointed leader of a task force may be a peer of the other members or he may be the occupant of a higher position in the formal hierarchy. In the latter case, there is likely to be little opposition to the appointed leader's assumption of his position as task force leader, because of his recognized position of authority in the larger organization. The appointed leader has a strong claim on authorized power and is in a good position to foster the development of endorsed power if he is careful to exercise his power only in those instances when it is sanctioned and expected by the other group members. If a leader usurps his power in any way, he is apt to lose any endorsed power he may have gained.

Subordinates know the limits of authorized power and will insure that its use is not extended beyond these limits without their approval. In this way endorsed power not only increases the power of the power wielder because of the group's sanction, but also limits the use of that power by providing strong incentive for the leader to exercise his power judiciously and only within the accepted boundaries. For example, the appointed discussion leader of a brainstorming group is expected to guide the members in accordance with the rules of brainstorming; however, he may destroy the effectiveness of the group if he usurps his power by attempting to force his preconceived decisions on the group.

If the leader of the task force is appointed from a group of peers, he will be accorded a degree of authorized power by virtue of his appointment; however, as a member of the peer group his performance is likely to be closely scrutinized and evaluated by the other members to see if he is worthy of the position. While there is likely to be less tension generated in this situation than in the case

where peer members compete for the position of leadership, the peer appointed as group leader will be more dependent upon his personal characteristics to prove his ability than will a person occupying a position of leadership due to his position in the formal hierarchy. Role expectations of formal positions are defined without regard to the personality of the role occupant; however, informal role positions are dependent upon the personal characteristics of the position occupant (Lecture by W. Richard Scott, Fall 1970, University of Kansas). While the position of leader is formalized by the act of appointment, the position is considerably less formal than those occupied by persons in the formal hierarchy of the larger organization.

Thus, the concept of role formalization is a matter of degree or of position on a continuum extending from completely informal at one extreme to entirely formal at the other extreme. The higher the degree of fomalization, the less dependent the role occupant is on his personal characteristics to define the expectations of the role position. As Raven and French (1958) have argued, "the very occupation of a key position in a structure lends legitimacy to the occupant" (p. 409).

The series of experiments conducted by Raven and French clearly indicate the importance of the perception by group members that the appointed leader has a legitimate right to occupy the position of leadership. Empirical evidence supported the hypothesis that the more an individual perceives that a person occupying a position of leadership has a legitimate right to his position, the more that individual will perceive that the leader is justified in prescribing behavior for him (Raven & French, June 1958, pp. 88-89).

If the leader is perceived as not having a legitimate right to

his role position, we can predict that he will have an adverse effect on the group's performance. For example, if an individual appointed to be the task force leader is perceived by the group as having been selected because he is the commander's "favorite" instead of another group member who is perceived as more deserving of the position for any reason, the manifestation of the group's resentment will probably be evident in reduced effectiveness. Raven and French (September 1958) observed in their experiments that overcompliance with directives issued by leaders perceived as illegitimately occupying positions of authority is one way in which the group may undermine effective group performance, particularly where communication is restricted (p. 409). Thus, if such a task force leader were to ask a group member for a specific piece of information, the explicit answer would be given; however, critical related data might be withheld, resulting in an erroneous or incomplete conclusion. Cooperation, integration of effort, and uninhibited communication are crucial to efficient and effective group brainstorming; a leader who is perceived by the group as having no legitimate right to his role position may tip the delicate psycho-social balance that seems to be required for the free expression of ideas in a group setting.

As described earlier, the mere existence of a status hierarchy in the task force will have serious implications for the communication network which evolves. An authority structure creates similar barriers to communications which are apt to be stronger than those created by status differentials because of the authority figure's potential to invoke sanctions. Even in the ideal case where the leader posses both endorsed and authorized power (which, fortunately, need not be an unusual situation), his occupancy of a formal position of authority will

affect the communications within the group. The leader must be fully cognizant of the predilection of group members to withhold information which may appear critical of his ideas. Leavitt demonstrated the need for two-way communications in nonroutine problem-solving situations (Leavitt, 1969, pp. 138-152). If the task participants fail to freely interact with the group leader, a vital source of feedback information will be lost.

A well-trained task force leader need not be the cause of barriers to free communication; in fact, he may serve as a catalyst to generate a highly efficient and effective communication network. For example, it is often difficult for minority views to be heard in a group setting; however, an alert leader will insure that both sides of an issue are adequately considered and evaluated (Secord & Backman, 1964). Obviously, it is especially important that all views be aired in a brainstorming session.

A skillful leader will not only direct communications toward solution of the immediate problem, he will also allow and even encourage the communication of interpersonal feelings when appropriate to prevent the creation of another kind of communication barrier. As Leavitt argues, forcing conversation to be directed only to the business at hand must be avoided "because it prevents the communication of interpersonal feelings, and uncommunicated interpersonal feelings, in turn, complicate and sometimes prevent the communication of facts" (Leavitt, 1969, p. 250).

Finally, the position of formal leader is particularly important when the task force members are a heterogeneous group with respect to status. Barnard has collected evidence which demonstrates

that a group of individuals who are unequal in status do not work well together as equals; however, where the status differentials are formally recognized, such persons do work well together (Scott, 1970, p. 352).

Task force design is not a simple process. If the task force is to be effective, careful consideration must be given to the selection of the members and the group leader with respect to the nature of the task to be performed. Blau and Scott have stated that where group superiority exists, it is a function of communications within the group and it is basically attributable to three group processes:

> (1) the sifting of suggestions in social interaction serves as an error-correction mechanism; (2) the social support furnished in interaction facilitates thinking; and (3) the competition among members for respect mobilizes their energies for contributing to the task. (Blau & Scott, 1962, p.121)

Any restrictions on free communication within the group will severely limit the functioning of the first two group processes cited above. Additionally, in the presence of a formal status structure, members are apt to accept their position with less motivation to compete for respect, thereby lessening the mobilization of their energies for contributing to the task (Blau & Scott, 1962).

Even this brief review of brainstorming experiments and small group methods makes one point very obvious, an efficient brainstorming group is not likely to emerge just because the commander calls together some of his subordinates and tells them to brainstorm a problem. The more a commander/manager knows about small group methods, the greater are his chances of developing an effective brainstorming group.

CHAPTER 3

METHODOLOGY

General Discussion

Before describing the procedure used to actually conduct the experiment, it is necessary to first discuss the three major variables which are most often cited by advocates of group brainstorming when criticizing the body of brainstorming experiments. This study has been designed to counter these criticisms as much as possible by optimizing the conditions for group brainstorming to the greatest extent practicable while still maintaining a realistically attainable situation in a military environment.

It should be remembered that the brainstorming technique per se is not at issue in this study. The issue concerns the effects of group participation as compared to pooled individual effort when using the brainstorming technique. While the preponderance of the evidence to date suggests the superiority of pooled individual effort over the efforts of individuals interacting as a group, the efficacy of group brainstorming is by no means a dead issue. A very real question still exists. One need only read or watch the mass media to see that brainstorming remains a popular concept. At least by implication, group brainstorming is not only a viable, popular procedure used by relatively unsophisticated practitioners, it is also a recommended technique for fostering group ideation at the highest levels of industry and government. This study will help answer whether such popularity

is warranted or misplaced.

The participants in the experiment were not informed of the exact nature of the study in advance in order to enhance a feeling of ego-involvement in the problem to be brainstormed; however, after each of the brainstorming sessions, interested subjects were briefed on the purpose of the study and informed that the findings will be published.

Group Size. According to Alex Osborn, the most effective size of a brainstorming group is between five and ten members (Osborn, 1948). Thus, it is argued that the 4-man groups used in the Taylor et al. (1958) experiment were really too small to take full advantage of the benefits of the brainstorming technique. In order to determine the optimum group size for this experiment it is necessary to consider two major factors: the number of participants that a commander can reasonably expect to assemble for a group brainstorming session, and the number of participants suggested by a review of the literature concerning group methods.

Since it is reasonable to assume that a military commander will be able to assemble the optimum number of participants suggested by Osborn in most situations where group brainstorming might reasonably be used (for example, a commander is unlikely to take the time to brainstorm a problem when a quick decision is required at a tactical command post during the height of a battle), the major determinant of group size will be the evidence provided by the results of experimentation involving the effectiveness of group discussion. While Taylor's groups may have been too small, a survey of the literature concerning the structural properties of groups reported by Cartwright and Zander (1968) reveals "that group processes are more effective in smaller

groups than in larger ones" (p. 499). The question becomes one of how large a group is too large? In their experiment reported in 1970, Bouchard and Hare found that, contrary to Bouchard's earlier hypothesis, as group size increased, the relative superiority of nominal groups over real groups increased. Ernest Bormann (1969) in his book, based in part on the results of small-group communication research conducted at the University of Minnesota, states,

> The optimum size for a discussion group varies from five to seven and a group of ten or eleven is often too large. Five is an excellent number. People in groups with fewer than five members complain that their group is too small, their viewpoints too narrow, and their resources too limited. Groups composed of an even number of people tend to be less efficient than those containing five or seven people. (pp. 3-4)

Based upon the evidence concerning group brainstorming that is currently available, it appears as if a 5-man operational group is the best compromise.

Group Structure. The criticism concerning group structure is basically a criticism of the fact that Taylor's real groups were leaderless groups. Osborn places considerable importance on the role of the discussion leader with particular emphasis on his function as a facilitator to focus the efforts of the group and insure compliance with the rules of brainstorming (Osborn, 1953, p. 301).

The review of the literature on communication networks in small groups suggests that there may be some question as to the most appropriate group structure for a brainstorming session. For example, Harold Leavitt (1964) states that the non-equalitarian networks that he refers to as "star" networks (those with a leader in a centralized position), "impose a clear-cut organization on the group, defining each person's job and leaving little leeway for wandering away from

that job. As a consequence, those groups get started faster and work faster once they have started" (p. 237). On the other hand, Leavitt concludes that the more equalitarian networks may be more creative. The communication network which evolves in a group is largely a function of the authority structure. Perhaps the real question is whether a proficient discussion (brainstorming) leader can in some way combine the benefits of both the equalitarian and nonequalitarian communication networks in a brainstorming session. Can a discussion leader focus the efforts of the group on ideation while enforcing the rules of brainstorming without causing the communication network to become centralized to the degree that it hinders creativity? It appears as if the addition of the procedural rule concerning sequential response as suggested by Bouchard may help solve this dilemma while also enhancing a more equitable contribution of ideas from the more inhibited members.

Time. The time that should be allotted to each brainstorming session is subject to the same kind of analysis as the question of group size. Taylor et al. (1958) allowed each group (or individual in the case of nominal group members), a total of 12 minutes to brainstorm a problem. They wrote,

> During the pretesting, both with individuals and with small groups, attention was devoted to the question of what length of time should be allowed for work on each of the problems selected for use. What was wanted was a span of time long enough so that members of groups of four would have adequate opportunity to express all the ideas which occurred to them within the working period and at the same time short enough so that individuals would not become bored by being forced to continue work on a problem long after they had essentially exhausted their ideas. (p. 29)

Despite Taylor et al.'s attempt to experientially establish a reasonable time frame for their brainstorming experiment, critics argue that 12 minutes is insufficient time for a group to exhaust all their ideas.

It is possible that too short a period of time for the brainstorming session may favor the nominal group. Individuals working in isolation can devote all of their time to thinking of ideas. Members of real groups must devote a portion of their time to listening to others and awaiting a chance to express their ideas.

It seems reasonable to hypothesize that the optimum time required to conduct a group brainstorming session will depend upon several different variables, such as the size of the group, the structure of the group, the expertise of the group with respect to the brainstorming technique, and the nature of the problem to be brainstormed. Since each of these variables generates a testable, but as yet unproved hypothesis, the decision concerning the amount of time to be allocated to each session must be somewhat subjective and arbitrary.

Because of the fact that time is often a constraint and almost always a factor, it was decided to keep the time of each brainstorming session as short as seemed practicable while still increasing the period sufficiently to overcome the criticism of the Taylor et al. experiment. Each brainstorming session in this experiment was conducted for a 20-minute period - more than a 50% increase in time over the time allotted in the Taylor et al. experiment.

The question of time is also important in another respect. If the nominal group results are going to be compared to the operational group results, the time alloted to each session must be comparable. As was discussed above, the nominal group seems to have a time advantage if the equal man-hours approach is taken and insufficient time to present essentially all ideas is provided. This problem is especially perplexing because it is very difficult to quantify the additional

amount of time that should be allocated to the operational group to make the sessions more equitable by some objective measure of "equal" time.

Ideally, time would not be a factor at all with both individuals (nominal group members) and operational groups brainstorming the problem until they run out of ideas. The findings of both Taylor et al. (1958) and Dunnette et al. (1963) suggest that after 10-12 minutes the idea production is nearly complete if the responses are oral. Rotter and Portugal (1969) demonstrated that 16 minutes are apparently sufficient for written responses. The evidence supports the assumption that 20 minutes will be more than enough time for both the individuals and the operational groups to brainstorm a problem.

The problem of inequitable time distribution may be lessened by having the individual nominal group members write their ideas; the operational group members will present their ideas orally. The ideas expressed in the operational group session will be recorded in writing by a separate individual who is not a member of the working group. Thus, while both kinds of groups should have ample time to express, for all practical purposes, all of their ideas, the inherent inefficiencies of waiting and listening in the operational group setting will be offset to some degree by the requirement for a written response from individuals in nominal groups.

If a commander/manager directs individuals to develop possible solutions to a problem, the individuals will almost certainly write down their ideas. On the other hand, if the ideas are generated in a group setting, it is altogether possible that an individual will be designated the recorder to write down the ideas that the group members present. Thus, it appears as if the experimental design is sound not

only from the standpoint of previous experimental data, but also from a pragmatic, realistic viewpoint.

Before discussing the method used in this experiment in detail, it is important to keep two points in mind. First, the brainstorming technique per se is not at issue. This study is concerned with the relative effectiveness of group participation in a brainstorming session as compared to pooled individual effort. There is ample evidence to support the fact that brainstorming can improve ideation. There are obviously other techniques which also improve ideation; the synectics technique, for example, has already shown some promise as a potentially more powerful procedure than brainstorming under some conditions (Bouchard, 1971, and Bouchard, 56, 1972). However, this experiment will focus on brainstorming alone.

The second point concerns the experimental design. It is very important that the design conditions are not so artificially contrived that the results are only useful with respect to this one isolated circumstance. In order to meaningfully evaluate the utility of group brainstorming, the operational group should be as carefully composed and orchestrated as is realistically attainable in order to optimize the technique. However, the key phrase is realistically attainable. The operational group must be composed of the kind of members that are readily available to a military commander/manager and the technique employed must be operationally attainable in a typical military setting. For example, if the discussion leader/facilitator requires a Ph.D. in speech communications and the technique requires the use of closed circuit television, whatever the outcome of the experiment, the findings would have limited value to the military. This experiment is

designed with these constraints in mind.

The Subjects

The subjects for this experiment were US Army officer students attending the 1976-1977 Class of the United States Army Command and General Staff College. The 40 subjects that brainstormed the problem individually were all volunteers from Division D of the College. After the brainstorming session, the 40 individuals were randomly assigned to eight nominal groups of five members each by use of a random number table.

The 40 subjects that participated as members of the eight operational groups were selected from volunteer students in the Term 2, Personnel Management - Human Resource Development Course. Each 5-member operational group was composed of students who were members of an actual assigned work group in the described course. The volunteers maintained work group integrity during the experiment because in this way an operational group more nearly simulates an actual brainstorming group that might be formed by a military commander/manager. The work group members had worked together in small group sessions for approximately six meetings before the experiment was conducted. Thus, the operational group members were not strangers and had at least a modicum of experience working together in a group. It is likely that a brainstorming group formed in the military will be composed of members who have at least some limited experience working together in a group.

Each workgroup in the Personnel Management - Human Resource Development Course had an assigned assistant instructor, selected

from among the students in the overall Command and General Staff College class on the basis of an academic background in a related area. The assistant instructors served as the experimenters for their own workgroups. Their duties consisted of reading verbatim instructions provided by the author of this study and recording verbalized ideas on a chalkboard. The experimenters did not participate in brainstorming.

The only restriction on the students in the course was that they could not have a graduate degree in the behavioral sciences. Thus, the sample of students that comprised the operational groups did not include a select group of experts relative to nominal group members.

The operational groups were formed by asking each workgroup for volunteers to participate in an experiment. By use of a random number table, five students were randomly chosen from among the volunteers if more than five volunteered (the workgroups are composed of approximately 8-10 students per workgroup), and one of the five students was randomly selected as group discussion leader/facilitator. A sixth student was assigned as recorder; the recorder, like the assistant instructor/experimenter, did not participate in the brainstorming.

The Problem

The findings described in Chapter 2 showed that, while the kind of problem brainstormed does have an effect on the number of ideas generated, nominal groups maintained their superiority over real groups for both real and imaginary problems. Since a military commander/manager will most often be concerned about real, ego-involving problems, only that kind of problem was evaluated in this experiment. The problem is ego-involving in the sense that the group members perceive a personal interest in the solution of the problem to be brainstormed.

While a study of other kinds of problems may be desired in the future, time constraints permitted the evaluating of only one problem in this experiment.

The problem was read verbatim to all subjects as follows:

> The Chief of Staff of the Army recently expressed his deep concern about the physical condition of all army personnel. It is obvious that improved physical fitness will be a priority goal in the coming months. The Commanding General of the Command and General Staff College publically stated that the college must set an example of physical fitness second to none. In order to achieve this goal, the commanding general has challenged his staff to brainstorm the problem and provide him a list of challenging innovative ideas on how to improve the physical fitness of all members of the college.
>
> You have been selected to provide ideas concerning ways that the physical condition of students can be improved. You are not restricted in any way; the class director wants as many ideas as possible. He is not looking for detailed programs or lengthy explanations of your suggestions. He simply wants as many ideas as you can think of concerning ways that the fitness of C&GSC students can be improved. The ideas will be sorted and evaluated at a later time, so don't worry about how good the ideas are at this time. Don't hesitate to present wild ideas; no matter how crazy the idea may seem to you, it might stimulate a great idea in someone else.

The following abbreviated problem statement was written on a chalkboard for all to see throughout the brainstorming session:

HOW CAN WE IMPROVE THE PHYSICAL FITNESS OF C&GSC STUDENTS?

The Procedure

Nominal Groups. The 40 individuals that composed the nominal groups were gathered in a single classroom for the brainstorming session. The following verbatim instructions were read to the assembled group by the chief experimenter (the author of this study):

Before we begin, please accept my thanks for agreeing to help me by participating in this exercise. I know there are many demands on your time already. I really appreciate your assistance.

Because of the nature of the exercise, it is necessary that I read the following instructions verbatim; please pay close attention. I will answer your questions after completing the instructions.

This exercise is designed to accomplish two purposes. First, you will help solve a problem which not only affects us directly as students, but also affects the army as a whole. The problem concerns physical fitness. Second, you will help evaluate the effectiveness of a technique you have probably all heard about before - brainstorming.

In order to accomplish our second purpose, an evaluation of the brainstorming technique, it is very important that you follow my instructions as closely as possible.

Two rules are particularly critical. First, please do not discuss the problem that I will present to you shortly with anyone outside of this room until after the first of February. Second, please work alone at your table. Treat this exercise

as if you were taking an examination. Do not talk with your tablemate or look at his paper. This must be your individual effort for the evaluation to be valid.

At this time, please put your student number in the upper right corner of the paper in front of you. If you use more than one sheet, be sure your student number is on each page. I must ask you to write as legibly as possible; you will have plenty of time.

Before giving you the problem that you will brainstorm, I want to emphasize the four rules of brainstorming that you should follow to the best of your ability. Brainstorming is a technique designed to facilitate the generation of ideas. If you follow the simple rules, you will think more creatively and with a far greater production of ideas.

(1) Criticism is ruled out. Write down whatever ideas pop into your head. Don't try to judge your ideas in any way.

(2) Be bold and innovative. The wilder the ideas the better. Don't hold back; let your imagination soar. Have fun.

(3) Look for combinations. A new twist to an old idea may develop into a whole new concept. Don't be afraid to combine old ideas or build on them to develop more ideas.

(4) The name of the game is quantity. Try to list as many ideas as you can. Remember, you are not trying to evaluate; you are trying to generate. Give your mind a work out. It's fun.

Since it is critical that you try to follow these four guidelines, I have written the key words on the chalkboard to help

remind you of the rules. (The following list is written on the chalkboard in full view of all the subjects: (1) Do not criticize or judge ideas; (2) Wild ideas are desired; (3) Look for combinations; (4) Quantity is the goal).

Now carefully listen to the problem that you will brainstorm. (The problem is read verbatim at this point).

Do you have any questions concerning the procedure or what is expected of you? If there are no (further) questions, please begin listing your ideas. I will stop you after 20 minutes. If you run out of ideas before the time is up, please remain seated and let your mind wander, some more ideas may occur to you. Begin work.

After the 20-minute brainstorming period was completed, the subjects were instructed to cease work and the papers were collected. The subjects were reminded to avoid any discussion of the problem outside of the room until after the experiment was completed - February 1977. At this time, all questions concerning the experiment were answered.

The individual responses were sorted into eight 5-subject nominal groups using a random number table. Each group was then codified by a two digit alphanumeric. The first digit was the letter "N" for nominal group; the second digit was the group number, one through eight. Thus, the alphanumeric "N5" represented nominal group number five, or all the ideas generated by the five subjects randomly assigned to that group. In the case where more than one individual listed essentially the same idea, the idea was only counted once.

The next step was the construction of the master ledger. The

master ledger was created by analyzing a set of individual responses and listing each separate idea on the left side of the ledger. The right side of the ledger consisted of 16 columns representing the 16 different groups. A check mark in any of these columns served to identify the group(s) that generated the specific idea. Next, another set of individual responses was similarly catalogued; however, only previously unrecorded ideas were added to the ledger. Ideas already listed were credited to the group by simply placing a check mark in the appropriate column. This procedure was continued until all the ideas were listed. In this way, totals were easily calculated without duplication.

Both the author and his wife evaluated the responses in an attempt to avoid duplication of ideas, while at the same time giving credit for each different response. Although this analysis was necessarily subjective, the same two judges evaluated all of the data in an effort to achieve consistency.

Operational Groups. The eight operational groups each met in a separate classroom for the brainstorming session. Each operational group was composed of five subjects who were also members of an assigned work group in the Human Resource Development Course; the student assistant instructor acted as the experimenter for the operational group formed from his/her workgroup. The discussion leader/facilitator for each group was randomly selected by the assistant instructor from among the five group members.

The chief experimenter, the author of this thesis, briefed the eight discussion leaders/facilitators before the day of the actual experiment concerning the duties of their position. The briefing consisted of a short discussion of the brainstorming procedural

rules to include the sequential response procedure; however, neither the nature of the problem to be brainstormed nor the actual purpose of the experiment was mentioned. The assistant instructors and the recorders were fully briefed on the experiment in advance.

The five operational group participants were seated in a "U" around a table; the recorder sat off to one side; and the assistant instructor stood at the open end of the U in front of a chalkboard. The discussion leader/facilitator sat in the first seat at the top of the U on the right side facing the chalkboard.

Prior to the start of the brainstorming session, the assistant instructor read the following verbatim instructions to the group:

> Before we begin, please accept my thanks on behalf of John Wattendorf for agreeing to help in the conduct of this exercise. Because of the nature of this experiment, it is necessary that I read the following instructions verbatim; please pay close attention. I will answer your questions after completing the instructions.
>
> This exercise is designed to accomplish two purposes. First, you will help solve a problem which not only affects us directly as students, but also affects the Army as a whole. The problem concerns physical fitness. Second, you will help evaluate the effectiveness of a technique you have probably all heard of before - brainstroming.
>
> In order to accomplish our second purpose, an evaluation of the brainstorming technique, it is very important that you follow my instructions as closely as possible.
>
> I have selected (name) to be the discussion leader or facil-

itator. He will participate as an active member of the group, but he will also help keep you on track by enforcing the brainstorming rules.

Before giving you the problem that you will brainstorm, I want to emphasize the five rules of brainstorming that you should follow to the best of your ability. Brainstorming is a technique designed to facilitate the generation of ideas. If you follow the simple rules, you will think more creatively and with a far greater production of ideas.

(1) Criticism is ruled out. Try not to be inhibited in any way. Suggest whatever ideas pop into your head. Try not to judge your own ideas or anyone else's ideas in any way. Don't criticize, create.

(2) Be bold and innovative. The wilder the ideas the better. Don't hold back; let your imagination soar. Have fun.

(3) Look for combinations. A new twist to someone else's idea may develop into a whole new concept. Don't be afraid to combine the ideas of others or build on them to develop more ideas. Don't be afraid of stealing someone else's thunder. This is a group effort.

(4) The name of the game is quantity. Try to think of as many ideas as you can. Remember, you are not trying to evaluate, you are trying to generate. Give your mind a work out. It's fun.

(5) In order to allow each of you to contribute your ideas in an efficient manner, you will be asked to present your ideas sequentially. That is, each of you, in turn, will present one

idea, passing the turn clockwise starting with (name of discussion leader). If you cannot think of an idea on your turn, simply say "pass" and the turn will pass to the individual on your left.

Since it is critical that you try to follow these five guidelines, I have written the key words on the chalkboard to help remind you of the rules. (The following list is written on the chalkboard in full view of all the subjects: (1) Do not criticize or judge ideas; (2) Wild ideas are desired; (3) Look for combinations; (4) Quantity is the goal; (5) Respond sequentially).

Before we begin brainstorming the actual problem, we will take 5 minutes to practice the technique on a sample problem. I will record the key words from each of your ideas on this board (the chalkboard directly in front of the seated group) to help stimulate your ideas and help you to make combinations. Don't be concerned about (name of recorder), he is simply recording your ideas; he is not going to take part in the brainstorming.

The practice problem is quite simple. You are all familiar with the common red brick used for construction purposes. Now I want you to use the brainstorming technique to try to think of as many alternative uses for a common brick that you can. (Name of discussion leader) please start the practice session.

(After 5 minutes, the assistant instructor stopped the practice and read the following instructions).

Now that you have a feel for the technique, let's get to the real problem. You will have 20 minutes to generate as many ideas

as you can. Please listen carefully to the problem. (The problem was read at this point.) Do you have any questions concerning the procedure or what is expected of you? If there are no (further) questions, please begin brainstorming.

The 5-minute practice session served as a warm-up or ice-breaker to help relax the group and to familiarize the members with the sequencing procedure. Since the nominal group members worked as individuals and did not interact with each other, and because they, therefore, did not use the sequencing procedure, the nominal groups did not need a practice session.

The experimenter wrote the key words of each idea on the chalkboard so that the members could see the ideas already generated and perhaps stimulate new ideas or recognize possible combinations. The nominal group members experienced the same advantage because they wrote their own ideas on paper.

The brainstorming was stopped by the assistant instructor after 20 minutes and the subjects were allowed to ask any questions they wished concerning the experiment. The members were asked to avoid any discussion of the experiment outside the room until after all the groups had completed the brainstorming session.

The operational group responses were codified in a similar manner to the nominal group responses. The first digit was the letter "O" for operational group; the second digit was the group number, one through eight. The ideas were added to the master ledger following the same procedure used for the individual (nominal group) responses.

The Analysis

After the master ledger was compiled, the total number of ideas generated by each group was calculated. These totals were then used to calculate the mean number of ideas generated and the standard deviation for both the operational and nominal groups. The results were analyzed using an analysis of variance as described in Chapter 4.

Even though the findings of the experiments reported in Chapter 2 clearly demonstrated the correlation between quantity and quality of ideas, it was decided to attempt to assess the quality of the ideas generated so that a comparison of quality could be made for this specific experiment.

Since an assessment of the quality of an idea, particularly an innovative or creative idea, is such a subjective analysis, three Command and General Staff College staff members were asked to independently judge the ideas.

The judges provided a broad spectrum of views. One judge is a retired Army colonel with a Ph.D. in Psychology. Another judge is an active Army colonel with a graduate degree in physical education. He is a recognized expert in physical fitness, a former physical education instructor at the United States Military Academy who currently writes a weekly column on physical fitness for the post newspaper. The third judge is an active Army major with a Ph.D. in Education.

The judges were asked to place each idea in one of the following categories:

P - a poor idea that does not merit further consideration because it would not improve physical fitness or would be totally impractical to implement.

A - an acceptable idea in that it might improve physical fit-

ness and at least has some possibility of implementation, however slight. In other words, an idea that is at least worthy of some consideration.

G - a good idea that either shows innovativeness with some possibility of implementation or a less creative idea, but one that can easily be implemented.

The judges were given a complete list of the ideas generated without any indication as to whether the idea came from an operational or a nominal group. The list is reproduced at Appendix A.

After the ratings were completed, each idea that had been placed into a given category by at least two of the three judges was assigned that rating. Any idea rated differently by all three judges was rated as an acceptable idea - neither good nor poor.

The mean number of poor, acceptable, and good ideas was then calculated for the operational and nominal groups and the results compared by an analysis of variance as described in the following chapter.

CHAPTER 4

RESULTS

Given the experimental conditions described in the previous chapter with the goal of increased ideation, the results of this study clearly demonstrate the unequivocal superiority of nominal groups over operational groups. The results also support Osborn's assumption that increased ideation will result in a proportionately greater number of "good" ideas; increasing the number of alternatives generated is also likely to increase the number of "good" alternatives generated.

The total number of ideas generated by each nominal and operational group is presented in Table 1 (p.77) along with the number of ideas judged to be in each of the three qualitative categories - poor, acceptable, and good.

The mean ($\overline{X}$), standard deviation (S), and variance (S^2) for each of the qualitative categories and for the total number of ideas generated for each of the two methods (nominal and operational groups) is presented in Table 2 (p.78).

An examination of the statistics presented in Table 2 reveals a remarkable consistency in the mean number of poor, acceptable, and good ideas generated by the two experimental methods - nominal and operational groups. Note, for example, that the mean number of ideas generated by operational groups in each of the qualitative categories can be estimated quite accurately simply by multiplying the respective statistic generated by the nominal group by the ratio of the mean of

TABLE 1

Raw Data Summary

		Categories			
Method	Group	P		G	Σ
N	1	29	39	9	77
N	2	47	52	16	115
N	3	24	34	12	70
N	4	20	38	11	69
N	5	45	47	19	111
N	6	42	59	27	128
N	7	39	53	8	100
N	8	28	57	13	98
N	Σ	274	379	115	768
O	1	13	20	12	45
O	2	23	17	3	43
O	3	20	31	6	57
O	4	55	32	13	100
O	5	36	28	8	72
O	6	20	31	6	57
O	7	9	27	10	46
O	8	14	46	14	74
O	Σ	190	232	72	494

TABLE 2

Mean, Standard Deviation, Variance

Method	Statistic	Categories P	A	G	Σ
N	$\bar{X}$	34.25	47.38	14.38	96.0
N	S	9.59	8.79	5.83	20.6
N	S^2	91.94	77.23	33.98	424.5
O	$\bar{X}$	23.75	29.00	9.00	61.75
O	S	14.07	8.19	3.64	18.18
O	S^2	197.94	67.00	13.25	330.44

the total number of ideas generated by each operational group to the mean of the total number of ideas generated by each nominal group. For example, using the method described, the estimated means of poor, acceptable, and good ideas for the operational groups are respectively:

$\frac{61.75}{96}(34.25) = 22.03$ compared to 23.75 actual

$\frac{61.75}{96}(47.38) = 30.48$ compared to 29.0 actual

$\frac{61.75}{96}(14.38) = 9.25$ compared to 9.0 actual

Thus, for this experiment, the nominal groups produced slightly more than 1.55 times the mean number of ideas generated by operational groups and this ratio was relatively consistent for each qualitative category of ideas. In other words, an increased total production of ideas results in a directly proportional increase in the number of ideas in each of the three qualitative categories.

In order to evaluate the significance of the difference between the methods, nominal and operational groups, a repeated measures analysis of variance was used. The repeated measures analysis of variance as described by Edwards (1950) was utilized because the three qualitative categories into which the total number of ideas for each of the 16 groups was divided were not statistically independent in essentially the same way that repetitive trials on the same group are not independent.

The repeated measures analysis of variance, using the data summarized in Table 1, is outlined below. For a complete discussion of the method, see Edwards (1950, pp. 284-296).

Total sum of squares = $(13)^2 + (23)^2 + (20)^2 + \ldots + (13)^2 -$

$$\frac{(1262)^2}{(3)(8)(2)} = 44732 - 33180.083 = \underline{11551.917}$$

Degrees of freedom = (3)(8)(2) - 1 = 47

Sum of squares between groups (intergroup variation) =

$$\frac{(45)^2}{3} + \frac{(43)^2}{3} + \frac{(57)^2}{3} + \ldots + \frac{(98)^2}{3} - \frac{(1262)^2}{48} =$$

$$36757.333 - 33180.083 = \underline{3577.250}$$

Degrees of freedom = (8)(2) -1 = 15

Sum of squares between methods (nominal and operational groups) = $\frac{(494)^2}{24} + \frac{(768)^2}{24} - \frac{(1262)^2}{48} =$

$$34744.167 - 33180.083 = \underline{1564.084}$$

Degrees of freedom = 2 - 1 = 1

Sum of squares from variation of individual group means about the means of the methods to which they belong:

(nominal) $\frac{(77)^2}{3} + \frac{(115)^2}{3} + \ldots + \frac{(98)^2}{3} - \frac{(768)^2}{24} =$

$$25708.0 - 24576.0 = \underline{1132.0}$$

degrees of freedom = 8 - 1 = 7

(operational) $\frac{(45)^2}{3} + \frac{(43)^2}{3} + \ldots + \frac{(74)^2}{3} - \frac{(494)^2}{24} =$

$$11049.333 - 10168.167 = \underline{881.167}$$

degrees of freedom = 8-1 = 7

Hence, sum of squares between groups in same methods =

$$1132.0 + 881.167 = \underline{2013.167}$$

Degrees of freedom = 7 + 7 = 14

(Of course, the sum of squares between groups in same methods may also be calculated by: 3577.25 - 1564.084 = 2013.167).

Sum of squares within groups (intragroup variation) = Total sum of squares - sum of squares between groups = 11551.917 - 3577.25 = 7947.667

Degrees of freedom = 47 - 15 = 32

Sum of squares between categories = $\frac{(464)^2}{16} + \frac{(611)^2}{16} + \frac{(187)^2}{16} - \frac{(1262)^2}{48}$ = 38974.125 - 33180.083 = 5794.042

degrees of freedom = 3 - 1 = 2

Interaction sum of squares for groups and categories = sum of squares within groups - sum of squares for categories = 7974.667 - 5794.042 = 2180.625

degrees of freedom = 32 - 2 = 30

TABLE 3

Summation of Ideas

	Categories			
Method	P	A	G	Σ
Nominal	274	379	115	768
Operational	190	232	72	494
Σ	464	611	187	1262

Sum of squares between cells (Table 3) = $\frac{(274)^2}{8} + \frac{(190)^2}{8} + \ldots + \frac{(72)^2}{8} - \frac{(1262)^2}{48}$ = 40881.25 - 33180.083 = 7701.167

Degrees of freedom = 6 - 1 = 5

Sum of squares between categories = 5794.042

(previously calculated; d.f. = 2)

Sum of squares between methods = 1564.084

(previously calculated; d.f. = 1)

Interaction sum of squares for categories and methods =

7701.167 - 5794.042 - 1564.084 = 343.041

Degrees of freedom = 5 - 2 - 1 = 2, (2)(1) = 2

Pooled interactions for groups and categories for each method

considered separately = 2180.625 - 343.041 = 1837.584

Degrees of freedom = 30 - 2 = 28, (7)(2) + (7)(2) = 28

TABLE 4

Repeated Measures Analysis of Variance

Source of Variation	Sum of Squares	d.f.	Mean Square	F	α=.01
Between methods: Nominal/Operational	1564.084	1	1564.084	10.88	8.86
Between groups in same method	2013.167	14	143.798		
Total between groups	3577.251	15			
Between categories: P,A,G	5794.042	2	2897.021	44.14	5.45
Interaction: categories x methods	343.041	2	171.520	2.61	5.45
Interaction: pooled groups x categories	1837.584	28	65.628		
Total within groups	7974.667	32			
Total sum of squares	11551.918	47			

The column in Table 4 headed α=.01 contains the critical value of F for which 1% of the area under the F Distribution is in the upper tail. Thus, with the null hypothesis that there is no difference between the mean number of ideas generated by nominal and operational groups, and the alternate hypothesis that nominal groups generate significantly more ideas than operational groups, the probability of rejecting the null hypothesis when it is actually true (Type 1 error) is less than 0.01. In other words, since the calculated F for the between methods variation exceeded the value of F at which the probability of a Type 1 error is not greater than 0.01, it is reasonable to assume that there is indeed a significant difference in quantitative ideation between nominal and operational groups.

Of course, the main effects between methods (nominal and operational groups) yields the same value of F, 10.88, that is calculated by a simple one-way analysis of variance. However, a one-way Anova does not address the source of the significant F. It does not show whether the difference between the groups is a function of the difference between the number of poor ideas generated, or the number of acceptable or good ideas, or some combination of the three categories. The main effects between methods simply demonstrates that, with respect to the total number of ideas generated by each group, an F of 10.88 is of such magnitude that it would have a larger value less than one time in a hundred in random sampling, if the nominal and operational groups had equal population means.

While this conclusion is significant, indeed it addresses the central issue of this study, it is also important to determine whether one of the qualitative categories exerted proportionately more influence

on the difference between methods than another. The second main effect of the analysis, resulting from the between categories variation, reveals that the difference between the qualitative categories was highly significant; however, this finding is not particularly noteworthy for this experiment. Even though the number of acceptable ideas generated had the greatest influence on the difference between methods by virtue of the fact that more acceptable ideas were generated than good or poor ideas, the significant question is whether one of the methods had a disproportionate number of ideas in one of the qualitative categories. In other words, if nominal groups had generated far less good ideas than expected based upon the total number of ideas, and, concomitantly, a proportionately greater number of poor ideas, the total number of ideas might remain the same. In such a case, the F for between methods variation would remain the same, but the interpretation of the difference between methods would be different.

The F test for interaction addresses the proportionate number of ideas in each category between the groups. Since the F test for interaction is not significant at the 0.01 level (nor is it significant at the 0.05 level where F would have to be greater than 3.34), the proportionate number of ideas in each qualitative category are not significantly different between the two methods. This relationship is perhaps best visualized by the graph shown in Figure 1, page 85. The mean number of ideas in each qualitative category are depicted on the upper line for nominal groups and on the lower line for operational groups. As the F for interaction effect increases, the lines depart more and more from a parallel relationship. The interpretation of the analysis of variance came largely from Minium (1970, pp. 353-376).

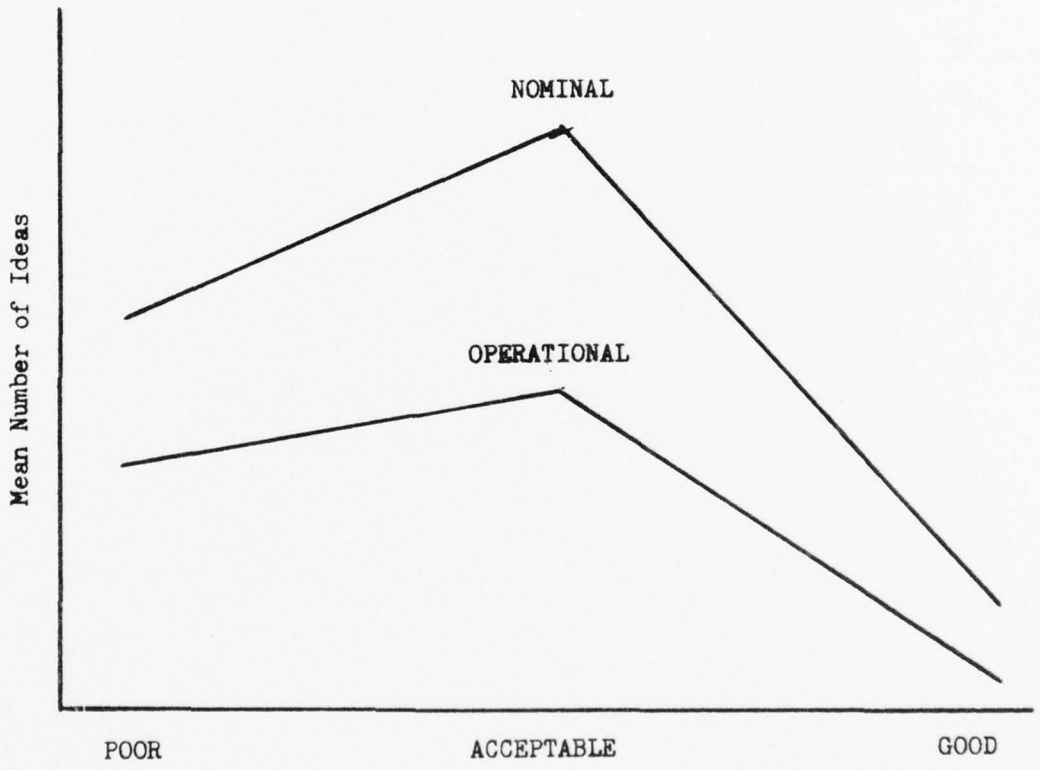

Figure 1. A graphical representation of the interaction effect.

In order to test whether the number of good ideas did in fact increase with the total number of ideas generated as hypothesized by Osborn (1953, p. 301), a Pearson r, product-moment correlation, was calculated. The number of poor plus acceptable ideas was computed for each group and compared to the number of good ideas for each group. The number of good ideas was not compared directly to the total number of ideas since the number of good ideas obviously makes up part of the total and, therefore, raises the apparent correlation.

Next, the number of poor plus acceptable ideas and the number of good ideas for each of the sixteen groups was converted to a standard z score so that both nominal and operational group data could be used in the same correlation. The analysis resulted in a positive correlation of $r = 0.48$ which is significant at the 0.05 level using a one-tailed test.

Although the three judges were purposely selected to bring different perspectives to their evaluations, it is worth the effort to analyze their judgements for consistency among the raters. An intra-class correlation was selected as the most useful tool to assess the degree of correlation among the evaluations of the judges.

In order to make the evaluation, poor ideas were assigned a rating of 1.0, acceptable ideas a rating of 2.0, and good ideas a rating of 3.0. Table 5 summarizes the data calculated for each judge and for the sum of the three judges.

Table 6 summarizes the factors calculated to determine the intra-class correlation.

Due to the large number of degrees of freedom, the intra-class correlation is highly significant; however, the correlation is

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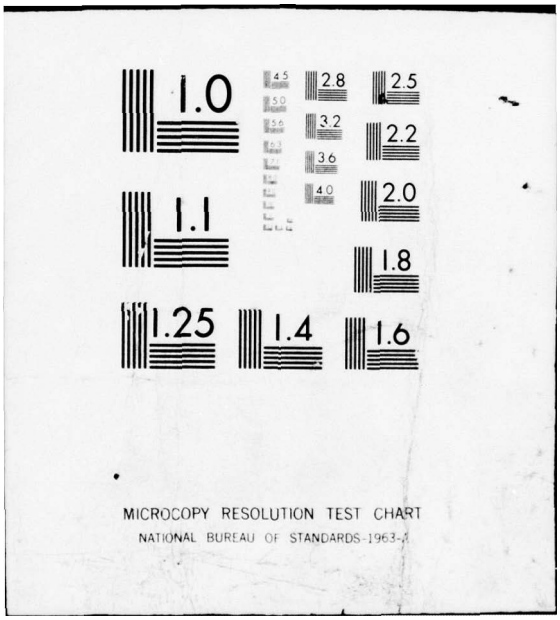
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TABLE 5

Mean and Standard Deviation of Judge's Evaluations

	Judge 1	Judge 2	Judge 3	Sum of Judg
Mean	1.8890	1.4765	1.9397	5.3052
Standard Deviation	.8178	.5187	.8113	1.6307
No. of Ideas	829	829	829	2487

TABLE 6

Factors to Determine Intra-class Correlation

	Sum of Squares	d.f.	Mean Sq
Total	1426.9574	2486	
Ideas	733.0490	828	.885
Residual	693.9084	1658	.418

relatively small.

A Pearson product-moment correlation was also calculated to assess the degree of correlation between each possible pair of judges. The results showed a small but highly significant positive correlation for each of the possible dyads as follows:

Between Judge 1 and Judge 2: $r = 0.34$

Between Judge 1 and Judge 3: $r = 0.39$

Between Judge 2 and Judge 3: $r = 0.31$

Each of the correlations was significant at the 0.001 level. Although the correlations are relatively small, the results are as expected because of the intentional selection of judges with widely different backgrounds and interests. Remember that an idea was only placed into the "good" category if at least two of the judges rated the idea good. Similarly, an idea was categorized as poor only if at least two judges rated the idea poor. An idea, however, was categorized as acceptable if two of the judges rated the idea acceptable or if all of the judges differed in their evaluations. In this way, the most controversial ideas were rated as acceptable, or as the definition of the acceptable category states, "at least worthy of some consideration."

CHAPTER 5

DISCUSSION AND RECOMMENDATIONS

Discussion

A major obstacle to the successful accomplishment of this experiment was the requirement for groups of individuals who had some experience working with each other in a small group setting. Since the primary purpose of the study was to be able to advise a military commander/manager on the relative merits of group participation in a brainstorming session as compared to pooled individual effort, ideally the subjects would be members of actual, functioning staffs. For example, the actual battalion staffs of an active division could be randomly divided into two groups for comparison, one to function as experimental, operational groups and the other as nominal groups. Such a study is planned to follow this experiment.

Because of the administrative difficulties inherent in such field research, it was decided to conduct a pilot study utilizing the resources available at the Command and General Staff College to test the basic experimental design and to determine the feasibility and desirability of a large scale field study. The problem of finding subjects who had worked together in small group interaction became a major obstacle.

The students in the second term Human Resources Development Course solved both the administrative problems, such as scheduling and availability, and the requirement for group experience with the other

group members. Unfortunately, there were not enough students in the course to provide subjects for both nominal and operational groups. Thus, the subjects for the nominal groups would have to be drawn from a technically different population - members of the class at large.

While the two samples, nominal and operational groups, were drawn from the same overall population, the class as a whole, the samples were not random since the operational groups were also members of the Human Resources Development Course. Although it can be argued that there is no significant difference among the subjects on any of the variables that would effect the outcome of the experiment (for example, rank, experience, educational background, etc.), such an argument cannot be proved and, therefore, the nonrandom selection of subjects must stand as a major weakness of this study.

It was decided that, for the purpose of this pilot study, it was more important to select operational group members who had worked together in a small group setting, thereby resembling an actual staff, than it was to prove random selection of the subjects from the same population. In other words, a part of the observed difference in the results between nominal and operational groups may be attributed to the difference between the students in the class at large and the students in the Human Resources Development Course, and such potential difference must be recognized and considered when assessing the results.

Time was unquestionably a factor in this experiment. While the previously cited experiments suggested that nominal groups are superior to operational (real) groups even when the time for a brainstorming session is increased significantly (for example, Campbell, 1968), the fact remains that time is a factor. Both nominal and real groups would have generated more ideas if more time were allotted to

the session. The evidence, however, indicates that nominal groups will maintain their superiority if the previously explained techniques are used exclusively.

The time variable was discussed in Chapter 3; however, several further observations are in order. In the operational group setting, some time was devoted to waiting for the experimenter to write the gist of a suggested idea on the chalkboard. In some instances it appeared as if the ideas would have flowed more quickly and smoothly if the ideas were not recorded on the chalkboard. It is also likely that the nominal group members devoted even more time to recording ideas since the complete idea, not just the essence of the idea or key words, were written, and also because the individuals were instructed to write as legibly as possible.

The recording of key words from each suggested idea on a chalkboard did seem to have the desired effect of facilitating the brainstorming rules to build on others' ideas and to look for combinations. When ideas are presented orally only, the visual stimulus of previous ideas is lost. The nominal group members, of course, had their own list of ideas to scan as a stimulus for new ideas. It appears that any time lost while waiting for the experimenter to record the idea on the chalkboard is more than offset by the advantage of the visual stimulus of previously suggested ideas. Group members can be trained to respond to ideas without waiting for the experimenters to write the idea on the chalkboard. This issue will be clarified in the subsequent field study.

Operational group members sometimes seemed compelled to clarify or justify an idea to the other members despite instructions to the contrary. In other words, operational group members tended to use part

ceived as unpopular or in possible violation of group norms, it appears as if the inhibiting effects of group brainstorming relative to individual brainstorming may be even more pronounced as observed by Dillon et al. (1972).

Perhaps a specific example will help clarify this observation. The problem (How can we improve the physical fitness of C&GSC students?) was ego-involving to the degree that the participants perceived that the outcome of the brainstorming might affect them directly. Student questions and comments following the experiment indicated that the students perceived a very high degree of ego-involvement. The problem was also apparently quite threatening. Since the participants felt that any suggested idea had the potential to be implemented, an idea suggesting a particularly distasteful solution to the problem was likely to be perceived as threatening. Thus, when a member of an operational group suggested that a way to improve fitness is to require mandatory participation in the Army Daily Dozen, he showed obvious discomfort at suggesting an idea which would obviously be unpopular.

An admittedly subjective analysis of the ideas suggested by the two kinds of groups did not reveal an obvious difference in the proportion of potentially threatening or unpopular ideas. While it seems likely that an individual submitting ideas anonymously in writing will be less inhibited than an individual presenting ideas orally to a group, that hypothesis is more obviously supported by an observation of the individual's behavior when he suggests a potentially threatening idea in a face-to-face group setting than by comparing the ideas actually generated in the two situations. While both nominal and operational group members are apt to feel some inhibitions when the problem is ego-

involving and the solution is potentially threatening, the person involved in operational group brainstorming is more likely to behaviorally exhibit greater inhibition and the results will be most manifest in his behavior while expressing such an idea. Nonverbal messages are likely to signal discomfort or nervousness and verbal messages will probably include time consuming elaboration and justification of ideas. A major impact on the experiment is that it seems to take longer for operational groups than for nominal groups to express some kinds of ideas.

A similar occurrence takes place if a wild or very unusual idea is suggested to a group. In spite of the rule advocating wild ideas, there seems to be a need to explain or elaborate on such an idea so that the suggestor does not appear silly to the other members.

It was obvious that some of the operational groups were better than others at presenting concise ideas in rapid succession without detouring to elaborate and justify suggestions. The same difference occurred among individuals working alone; however, if one or two nominal group members tended to elaborate and justify ideas, the other individual members generally made up for it. In the group setting, however, if one or two members tended to elaborate and justify ideas without any sanction from the facilitator or other members, the entire group effort was directly effected because other members' time was being used unproductively. It is also likely that the process is contagious; when one member justifies an idea, other members seem to feel the need to elaborate on their ideas as well. The group with by far the best performance among the operational groups (group 04 with 100 ideas) seemed most adept at producing concise, distinct ideas without elaboration.

The structure of the group is probably more critical for groups relatively unskilled in the group brainstorming technique than it is for groups who are adept at brainstorming. If the group members are comfortable with each other and relatively uninhibited in their expression and if they are skilled at functioning within the brainstorming rules, there is probably little need for a discussion leader/facilitator. In fact, unless the facilitator is skilled enough to allow such a group to function without his/her intervention, the presence of such a member with potentially higher status and possibly even power or authority can become dysfunctional and counter productive.

Nevertheless, most groups are neither so well versed in the technique nor so skilled in group methods that they can function without direction at such a high level of efficiency. A skillful discussion leader/facilitator will be a distinct asset to most groups attempting to brainstorm a problem. Even if the members are relatively unfamiliar with the technique, a brainstorming group can be relatively effective in the presence of a good facilitator.

A clear example of the negative impact of the discussion leader/facilitator was demonstrated in the performance of group 02 - the group with the lowest production of ideas. The facilitator simply did not grasp the essence of the brainstorming technique. He not only failed to enforce the brainstorming rules, he actively disrupted the process by asking such questions as, "That seems to be a pretty good idea, what do you (another member of the group) think of that suggestion?" He actively encouraged elaboration and justification. As a result, the group tended to violate the cardinal rule of brainstorming, the prohibition against judgement and evaluation. When a member of this group

finally summoned the courage to suggest a threatening, unpopular idea, it was only with obvious discomfort and considerable commentary. An effective, practiced facilitator could have made a very significant contribution to this group. In the subsequent field study, more time will be devoted to training the facilitator.

A major difficulty in conducting this experiment was the compilation of the ideas to form the master ledger. The key problem concerned a determination of what constitutes a distinct idea that should be added to the ledger as a separate entry. In many cases, it seemed almost impossible to determine whether the originator of an idea intended to communicate essentially the same meaning as a suggestion that had been previously entered on the ledger from another group, or whether there was, in fact, some slight difference in meaning, even just a nuance, that could distinguish it as a different idea. Such an evaluation is necessarily subjective; however, the author personally evaluated every idea generated as part of this experiment in an attempt to insure consistency. A second opinion, the author's remarkably patient wife, was sought whenever the decision seemed potentially controversial or difficult.

A brief scan of the master list (Appendix A - the list of ideas taken from the master ledger, but without the identification of the group or groups which originated the idea) will indicate the magnitude of the effort required to compile the ideas generated by 16 different groups. The list contains 829 different ideas, nearly 40 typewritten pages. Many of the ideas were suggested by more than one group. Most of the ideas were transcribed exactly, or at least essentially, as written by the individual or the group recorder; however,

in some cases, grammar, language, or spelling was corrected in the interest of clarity or propriety. Also, if the idea was suggested by more than one group, the wording of the idea was dictated by the group that was analyzed first during the compilation of the ideas on the master ledger.

In order to attempt to give credit to every possible idea, the general criterion established for comparing potentially similar ideas was to list the ideas as separate entries on the master ledger whenever any doubt existed as to whether the ideas were essentially the same or different. For example, one group suggested that more bike paths should be constructed on post; another group suggested the construction of bike trails. It is very possible that these two ideas represent essentially the same suggestion; however, it is also possible that the ideas are different. Bike paths may connote routes like roads or sidewalks connecting facilities on post; whereas, bike trails may connote more rustic, scenic routes such as a forest trail to be used strictly for pleasure or exercise rather than as a path leading to some specific destination.

A review of the master list reveals that a relatively straightforward suggestion, such as "perform physical fitness exercises," can be modified into many different ideas simply by adding answers to such questions as: how many?, what kind?, how often?, how supervised?, how long?, mandatory or voluntary?, what rewards?, what punishments?, what standards?, alone or in groups?, what time of day?, where?, what facilities?, what equipment?, and so forth. Again, it became a matter of subjective evaluation to determine whether the difference between two ideas was sufficient to warrant separate entries on the master ledger.

For example, is the suggestion for a mandatory run every other day sufficiently different from a suggestion for a mandatory run two or three times a week to warrant adding both ideas to the master ledger, or should the idea be added once, giving both groups credit for the single idea? Where the difference seemed potentially significant, the ideas were listed separately. When the ideas were perceived as essentially similar, the groups suggesting the idea were credited under one entry on the master ledger.

The point is not whether an actual difference in the ideas exists, nor how important such a difference may or may not be; the key was to give credit for each distinct idea. It is altogether possible that a slight change in the meaning of a suggestion may result in the difference between a very ordinary idea and a very good idea. Fortunately, the great majority of the difficult decisions concerning whether, in fact, an idea was separate and distinct from a previously recorded idea were decisions among ideas suggested by different groups. In such cases, the number of ideas attributed to a group was not affected; the decision really amounted to a question of the wording of the idea. On the other hand, when such a question arose concerning a possible lack of distinction between two ideas suggested by the same group, the decision was more significant since it directly affected the total number of ideas generated by that group. Very few decisions of this nature were required, and, when required, such decisions were made jointly by the author and his wife to maintain consistency.

Taylor, Berry and Block (1958) used the concept of unique ideas as one of the criterion by which the nominal and real groups were

compared. A unique idea was defined simply as an idea that was suggested by only one of the groups. While it is easy to calculate and compare the number of unique ideas generated by the nominal and operational groups in this study, such an analysis is not very useful or significant because of the difficulties involved in distinguishing separate, distinct ideas as described in the previous paragraphs. A significant number of the ideas designated as unique might be unique only in the sense that one group worded a suggestion differently from another. Uniqueness in this sense is not likely to correlate well with either quality or creativity.

Before concluding the discussion of the ideas, one other observation is worthy of note. Some of the subjects tended to suggest broad general categories of ideas rather than narrow, specific suggestions. For example, one individual might suggest that the formation of athletic clubs will improve physical fitness in contrast with another individual who lists a number of specific examples of kinds of clubs such as a judo club, a bike club, and a canoeing club. Obviously, more ideas are generated when specific suggestions are cited than when only broad, general categories are presented. In this study, both the nominal and the operational groups appeared to have a mix of general and specific ideas; however, as expected, the groups with more specific ideas tended to generate the greater total number of ideas. The instructions to the subjects in the proposed field study will adress this issue in detail to make sure that the participants understand more clearly what constitutes an idea.

Since nominal group members worked alone as individuals, it was hypothesized that nominal groups might generate a greater pro-

portion of ideas with only slight nuances of difference among them than ideas suggested by operational groups. In other words, individuals working in isolation might think of ideas that are very similar, but differ just enough to be credited as separate ideas; whereas, operational group members might not present such slight differences, feeling that the essence of the idea was already suggested by another member. Because of the subjective nature of such an analysis, the data was not quantified; however, a study of the ideas suggested by the two kinds of groups revealed that neither operational groups nor nominal groups demonstrated inhibition with respect to the suggestion of ideas which are very similar. The operational groups apparently adhered to the brainstorming rule to seek combinations and build on the ideas of other members.

The experiments discussed in Chapter 2 clearly demonstrated the positive correlation between the total number of ideas generated and the total number of good ideas generated. Osborn's assumption that more ideas will result in more good ideas has been substantiated beyond a reasonable doubt (Osborn, 1953). The criticism that brainstorming will merely dredge up an increased number of worthless ideas without any substantial increase in good ideas has been refuted repeatedly. However, the question of what distinguishes a good idea from a poor idea remains a matter of rather unscientific speculation until and unless the idea is subjected to some test to determine its worth. History is replete with examples of ideas that were negatively evaluated as worthless and ridiculous by an overwhelming majority, only to discover later that the idea was in fact brilliant. Ask any Alaskan about "Seward's folly."

It is perhaps remarkable that two of the three judges independently assigned the same evaluation category to over 87 percent of the ideas. Remember that all three judges independently evaluated each of the 829 ideas recorded on the master list (Appendix A). Nevertheless, the subjective nature of such an evaluation is clearly demonstrated by the fact that in nearly 13 percent of the cases (105 ideas) all three judges differed in their assessment of the idea.

At least two of the three judges categorized nearly 40 percent of the ideas as poor (329 ideas). Since a poor idea was defined as one which either does not improve physical fitness or is totally impractical to implement, the high percentage of ideas evaluated as poor seems to indicate a particularly strict, critical appraisal by the judges. In the author's opinion, many of the ideas judged to be poor seem to have at least some potential to improve physical fitness and some possibility of implementation. For example, some evidence has been gathered to demonstrate that smoke-filled rooms are hazardous to health, at least for some people; nevertheless, the suggestion to ban smoking in the academic building was categorized as a poor idea. The suggestion "mandatory PT for all (daily dozen)" was rated as a poor idea. While it can be argued that mandatory physical training is not the best way to improve fitness, it seems difficult to support the view that such training is worthless or that it cannot be implemented.

The examples listed above were not included to criticize the judges in any manner; the examples merely demonstrate the degree of subjectivity involved in evaluating ideas which are proposed as possible solutions to a problem which does not have a clearly recognizable "good" solution. The evidence from previously cited experiments

suggests that, if the judges had rated more ideas as good or acceptable, the relative proportion of good, acceptable, and poor ideas between nominal and operational groups would not change significantly. In other words, if the judges had been less critical and rated twice as many ideas as good, the ratio of good ideas generated by operational groups to good ideas generated by nominal groups would remain relatively constant.

Recommendations

The evidence that has been gathered to date overwhelmingly demonstrates the superiority of pooled individual effort when brainstorming as compared to the results of group participation in brainstorming. Based upon the current state of the art, it must be concluded that group brainstorming is not the most effective way to increase ideation. If a military commander/manager is interested in the generation of as many potential alternatives to a given problem as possible in order to improve the probability of uncovering a really innovative, creative solution, the problem should be given to the appropriate personnel, for example, the staff, with directions to individually brainstorm the problem.

Depending upon the time constraints and individual preferences of the commander, the individual efforts may be gathered and screened by one individual, such as the chief of staff, before presentation to the commander. The commander may desire to screen the entire list of pooled individual ideas, or he may elect to have someone filter the ideas before he sees them. For example, a commander may direct the chief of staff to collect the ideas from the staff and present only the potentially "good" ideas (or the best ten,

best five, or some other arbitrary number of ideas) for final assessment. Obviously, the more the ideas are screened and filtered before they reach the commander, the greater the probability that a good idea will be buried in the process.

Time being one of the most precious commodities of any manager, it will often be impossible for the top man to devote the amount of time required to effectively analyze all of the ideas generated by individuals brainstorming a problem; however, it is necessary that the manager understand the potential consequences of filtering and take all possible precautions to make sure that the ideas are screened as nearly as possible in accordance with his wishes. It is absolutely critical that the screening process be completely distinct and separate from the brainstorming process. If the brainstorming effort is contaminated by preconceived notions of the desired outcome, creativity is likely to be inhibited.

It appears as if idea production will be most uninhibited if the results are presented anonymously. Individuals are less likely to hold back potentially unpopular or threatening ideas, if the ideas are presented anonymously. Similarly, the brainstorming rule to present wild ideas is more likely to be followed if the idea is not associated with the suggestor.

In summary, the problem should be presented to individuals to brainstorm by themselves with as few restrictions on potential solutions as possible and assurance that suggestions will be anonymous. After the individual efforts have been pooled into a comprehensive list of possible alternatives, any screening process used to whittle the list of ideas into a more manageable number must be accomplished

with great caution to prevent an inappropriate filter from blocking a creative solution.

The decision-making process that must ultimately take place is a separate problem altogether. It is very possible that the best way to decide upon the idea that will be put into effect is through group participation in the decision-making process. Social-psychological experimentation has clearly demonstrated the efficacy of participation of appropriate organizational members in the decision-making process. It was not the purpose of this study to investigate the process by which the final decision is derived; however, it is important to understand that, while the evidence currently available supports individual effort as opposed to group participation during the alternative generation or ideation phase of the problem-solving process, no such conclusion is suggested for the decision-making phase. Secord and Backman (1964) concluded "that one consequence of the group decision process is the likelihood that the decision would be carried out by group members" (p.393). They further suggested that "such consensus not only facilitates cooperative action, should the implementation of the solution require it, but also reinforces individual motivation to carry out the solution" (Secord & Backman, 1964, pp. 393-394).

While it is possible that group brainstorming may provide some utility when it is used following individual brainstorming, the results of the study conducted and reported by Rotter and Portugal (1969) indicate that, if increased ideation is the goal, more ideas (and, epiphenomenally, an increased number of good ideas) will be produced if the additional time is also devoted to individual as

opposed to group brainstorming methods are developed and verified, it appears as if the use of pooled individual brainstorming effort exclusively is better than any combination of mixed group and individual brainstorming.

A final word of caution is appropriate. While the evidence gathered to date distinctly favors individual over group brainstorming, the potential effectiveness of group ideation is not a dead issue. This study is only a pilot and cannot be considered as the final word on group participation in brainstorming. One of the operational groups, group 04, produced more ideas than the mean number of ideas generated by nominal groups. It may be possible to improve the brainstorming technique sufficiently to make group brainstorming superior to individual brainstorming through a combination of better trained group facilitators and group members, and by some modification of the brainstorming process. Nevertheless, until such improvements in group brainstorming are shown to be realistically attainable and more effective than pooled individual efforts, the best advice for a military commander/manager seeking to improve alternative generation is to present the problem to the staff for individual brainstorming as opposed to group brainstorming.

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APPENDIX A

MASTER LIST

MASTER LIST

1. More specific physical evaluation on academic report than satisfactory or excellent ___
2. Participation in athletic/physical endeavors on academic report ___
3. More visibility of commandant and deputy at sporting events ___
4. Make P.T. part of student evaluation (overall course grade) ___
5. Allow officers to certify ability to meet standards - no testing ___
6. Official (private) notification of those not physically fit ___
7. Discharge individuals who fail to meet Army minimum within certain time ___
8. Continue current program ___
9. Leave program up to each individual (no coercion) ___
10. Encourage exercise participation from the family level ___
11. Establish clubs to encourage participation in physical activities ___
12. Bike club ___
13. Karate club ___
14. Judo club ___
15. Tumbling club ___
16. All students walk to classes ___
17. Ban vehicular travel ___
18. Authorize bicycles only for post travel ___
19. Require wives to be in charge of husbands physical fitness program ___
20. Ski club ___
21. Make skiing equipment and transportation available ___

22. Make protective equipment available - knee pads, supports, etc. ___
23. Swimming club ___
24. Open outdoor swimming pools earlier ___
25. Canoeing club ___
26. Make canoes available ___
27. Family hikes (nature, sightseeing) ___
28. Backpacking - organize tours ___
29. Make backpacking equipment available ___
30. Organize bike tours (encourage family/community participation) ___
31. Provide free tennis instruction ___
32. Swim across the river, downstream for distance, etc. ___
33. Provide time for physical activity in the morning (too hot in PM) ___
34. Boat rowing upstream ___
35. Combat course ___
36. Two-hour lunch break ($1\frac{1}{2}$-$2\frac{1}{2}$) ___
37. Professional athletic director for the school ___
38. Trained staff to help with the exercise program ___
39. Class on all athletic events (instruction on sports) ___
40. Classes to certify officials ___
41. Wives participate in athletics ___
42. Provide formal classes on aerobics from trained instructors ___
43. Invite representatives from professional teams in the area to provide clinics during school time ___
44. Invite distinguished service athletes to address student body ___
45. Have college athletic teams appear at the college ___
46. Exchange students and coaches in local schools to provide latest ideas ___

47. Establish a chair for distinguished athletic director (like Military History) ___

48. Athletic Director from USMA present lecture on latest techniques ___

49. Athletic staff from USMA visit and conduct clinics in their sports ___

50. Invite TV sports personalities to become involved in setting-up a program ___

51. Invite retired professional athletes to visit and conduct clinics in their sports ___

52. Encourage hunting on a group basis ___

53. Encourage camping on a group basis ___

54. Encourage fishing on a group basis ___

55. Encourage hiking on a group basis ___

56. Encourage participation in manual labor, eg. construction, maintenance ___

57. Break class schedule with related manual work, eg. bridge construction, bunker construction, etc. ___

58. Run to school ___

59. Have training on physical fitness in all related areas ___

60. Randomly assign students to mandatory sports programs ___

61. More free time ___

62. Psychological appeals to individuals (benefits of fitness) ___

63. Establish class average goals ___

64. Wear athletic gear during class ___

65. Issue athletic equipment ___

66. Have midday sports program followed by normal class ___

67. Eliminate conflicts between sports/P.T. and academic requirements ___

68. Extend environment of instruction to outdoors - ie. Jayhawk terrain analysis ___
69. One afternoon a week for P.T. only ___
70. Wear combat fatigues more often to enhance image as combat leaders ___
71. An early tour of the gym by section - see facilities available ___
72. Physical fitness packet sent to students prior to attendance at C&GSC ___
73. Physical fitness as a true goal - cannot be perceived as always secondary ___
74. Don't go overboard - everyone doesn't have same capability ___
75. Increase emphasis in critical areas (combat units), reduce standards in noncritical areas ___
76. Allow time off during workday to use courts (handball, etc.) ___
77. Campaign on the need for physical fitness - Army needs and individual ___
78. Hold T-group sessions on physical fitness within work groups ___
79. Place greater emphasis on winter sports ___
80. Instruction on specific physical conditioning exercises for specific needs ___
81. Coordinate with Leadership Department (USAIS) concerning ongoing P.E. program ___
82. Example must be set by seniors - too many overweight COL's and LTC's ___
83. Professional referees for contact sports - avoid injuries ___
84. Designate one/two days per week as run/walk to class days ___
85. Sponsor (participate) scout walking events ___

86. Train one student from each work group in aerobics - responsible for teaching his/her workgroup ___

87. March to classes ___

88. Give athletic scholarships ___

89. Hold classes seven days a week ___

90. Give class credit for P.T. ___

91. Encourage sex ___

100. Conduct field problems ___

101. Detail students to nearby tactical units for a weeks training ___

102. Have intramural competition in adventure training ___

103. CG host informal gathering for team champions ___

104. Scores of intramural games on TV weekly (school TV) ___

105. Tape crucial intramural games for school TV ___

106. Permanent responsibility for PT program to someone other than Class Director ___

107. Add orienteering course to the basic curriculum ___

108. Make bicycles available (issue bicycles) ___

109. Inform the students about the requirements in other commands ___

110. Show pictures of obese officers in uniform (no names) ___

111. Discuss pictures of obese officers in uniform in leadership class (setting example) ___

112. Break the tie between physical fitness and competitive sports - poor players can be fit ___

113. Get information on what other Army organizations are doing about physical fitness and publish for students ___

114. Appoint a full time physical fitness NCO to establish, monitor and administer the program ___

92. Conduct field problems ___

93. Change classrooms each hour - concentrate on changing floors too ___

94. Select only athletes to attend C&GSC ___

95. Begin each class with warm-up exercises ___

96. Make each quarters occupant shovel snow ___

97. Require each student to own a dog and walk it every day ___

98. Close present parking lots and park cars at least a mile away ___

99. Eliminate custodian services - have students keep building clean ___

115. Give school credit for attending class on sports ___

116. Have student instructors teach classes on sports as student projects ___

117. Monitor attendance at scheduled activities ___

118. Establish a time that everyone must participate in the physical fitness program ___

119. Have qualified officials for the games ___

120. Physical appearance should be emphasized ___

121. Individual wall lockers in Bell Hall ___

122. Publish swimming pool hours more frequently ___

123. Make physical fitness part of OER evaluation ___

124. Have senior officers (COL's & GEN's) participate in sports with students ___

125. Have committee research new sports for persons over 30 ___

126. Guest speaker program on the value of athletics (e.g. famous athletes) ___

127. Set up athletic department with gifted military officer athletes in charge ___

128. Letter of counseling for those not meeting standards (last resort) ___

129. Field training on weekends for those that fail to meet standards ___

130. Publicly drum out of the course anyone who does not meet fitness standards ___

131. Reduce homework assignments to allow more time for P.T. ___

132. Dancing (ballet) as scheduled P.T. ___

133. Belly dancing as scheduled P.T. ___

134. Battle of the sexes program ___

135. Remove stairways and replace with knotted ropes for moving from floor to floor ___

136. Free dance classes ___

137. Take and publish full-length nude photos of students every three months ___

138. Do something about fat instructors who slouch in halls (court martial) ___

139. Pre-1957 uniform - less forgiving of the corpulent figure ___

140. Conduct classes on the importance of physical fitness ___

141. Family participation in games like TV show "Almost Anything Goes" ___

142. Allow wear of earmuffs in winter (to walk etc. to school) ___

143. Consult with physical fitness firm or expert ___

144. Schedule Gymkhanas (kind of meet) ___

145. Award academic points for athletic participation ___

146. Award academic points for individual improvement of physical fitness ___

147. Publicly identify those who are not physically fit ___

148. Emphasize group participation ___

149. All officers annually attend two weeks training at basic training type facility for P.T. and other - TDY and no dependents ___

150. P.T. committee as an applied student project ___

151. Stagger class hours to allow for use of gyms ___

152. Develop survival training ___

153. Develop confidence training ___

154. Keep chart to record pull-ups in each classroom - bar available

to be used on each exit or entry ___

155. Do isometric tension exercise when entering or exiting classroom, record on chart ___

156. Find out what other countries are doing (e.g. Volksmarches) ___

157. Find out what other institutions are doing ___

158. Grouping by ability ___

159. Grouping by age ___

160. Grouping by sex ___

161. Change uniform to allow P.T. in classroom ___

162. Schedule division championships on weekends to get more audience (family) participation ___

163. Weekly TV program on physical fitness - run from 7:45 to 8:00 (show in classroom) ___

164. Family boat races on Smith/Merritt lakes ___

165. Running club in each section with goal of one mile/man/day ___

166. Publish by computer printout weekly running club results by man and section ___

167. Goal of section logging most miles as of 1 June gets prize (e.g. day off) ___

168. Husband - wife running events or races ___

169. Establish goals of Army Physical Fitness ___

170. Educate all personnel on Army Physical Fitness Goals ___

171. Instructors attend and supervise all sports and turn-in evaluation on each participant ___

172. Require students to move the classroom furniture each period ___

173. Develop new physically-powered transportation - e.g. student bus where everyone pedals ___

174. Rucksack march ___

175. TV tape showing exercises that can be done in classroom (e.g. isometrics) ___

176. Get movie actress to make TV tape promoting fitness as "sexy" ___

177. Bring in Infantry EM from Fort Riley to comment on fat officer's effect on leadership ___

178. Instruction on use of exercise room equipment ___

179. Morning parade ___

180. Publish class sports information in post newspaper ___

181. Sponsor community marches ___

182. Limit parking to encourage walking or bike riding ___

183. Specific exercise program to meet individual needs (e.g. cardio-vascular) ___

184. Individual should set goals for himself and meet them ___

185. Mandatory "slimnastics" for overweight individuals ___

186. Conduct remedial P.T. for those who need based on test results ___

187. Have individuals certify progress (e.g. weekly aerobic points) ___

188. Mandatory program of P.T. depending on test score (number of days and supervision) ___

189. Mandatory P.T. for all (daily dozen) ___

190. Mandatory run daily for all ___

191. An exercise program developed by individual ___

192. Use kinesthetics utilizing electromuscular devices to determine best exercises for specific problem ___

193. Institute aerobics program for those below minimum acceptable level ___

194. Mandatory martial arts classes ___

195. Swim for your life program ___

196. Run for your life program - improve -push ___

197. Only count endurance type activity - i.e. do not credit bowling ___

198. Noon walks over established courses ___

199. Running does not have to be the core program ___

200. Isometrics ___

201. Daily dozen in classrooms during breaks throughout day ___

202. Use exercise machines ___

203. Mandatory P.T. in conjunction with current program ___

204. Post individual P.T. goals and progress on bulletin board ___

205. P.T. scheduled on weekly schedule with commensurate reduction in class time ___

206. Isometric exercises during lectures ___

207. 30 to 45 minutes relaxed P.T. session at end of day - become natural as lunch, not a strain ___

208. Establish physical fitness course similar to Para Vita in Europe - series of exercises along run ___

209. Supervised P.T. program in middle of day ___

210. Establish individual P.T. program under doctor's direction ___

211. Two week physical conditioning program at start of college as part of class schedule ___

212. Establish buddy system to monitor and encourage participation in individual program ___

213. Instruction on planning and developing an individual program ___

214. P.T. organized based on branch ___

215. Noncompetitive individual aerobics program ___

216. Encourage P.T. before beginning of school ___

217. Require everyone to run up and down stairs ___

218. Establish specific goals for each student based on entry level (monthly goals to measure progress) ___

219. Class Sports Officer - will supervise mandatory P.T. ___

220. Mandatory P.T. at the gym ___

221. Individual submit written plan to improve his fitness ___

222. Faculty advisor supervises P.T. program ___

223. Add jogging to scheduled P.T. ___

224. Add mountain climbing to scheduled P.T. ___

225. Add weight lifting to scheduled P.T. ___

226. Rope jumping (for time and different styles) ___

227. Realistic program for over 40's ___

228. Mandatory run two or three times a week (or weekly) ___

229. Concentrate on single events of PCPT for several weeks on scheduled basis ___

230. Strictly enforce current regulations ___

231. Mandatory group (section) participation in P.T. at least weekly ___

232. Send individuals who are not physically fit to a special training facility until up to standards ___

233. Regular exercise ___

234. P.T. electives ___

235. Keep good physical fitness records ___

236. Set standards (insure everyone has a goal) ___

237. Build P.T. into every aspect of student life ___

238. Swimming as a mandatory class sport ___

239. Develop set of exercises that can be done at desk/table ___

240. Someone lead class in exercises in classroom each morning ___

241. Require a given number of repetitions per day per student on exercise devices in Bell Hall ___

242. Everyone take a 10-minute walk every hour (during breaks) ___

243. Require all students to wear weight belts and leg belts ___

244. Require all students to wear pedometers and log so many miles per day, week, month ___

245. Research in exercise to determine which are most needed by students ___

246. Inform students on isometric exercises ___

247. Recorded exercise progress reviewed by fitness expert to study individual needs ___

248. "Chinese" type group exercises in classroom ___

249. P.T. mandatory regardless of age ___

250. Adventure training as elective ___

251. Encourage use of the gym for jogging ___

252. Conduct cross country walks - like in Germany ___

253. Provide information on 5BX Plan ___

254. Daily physical fitness program ___

255. Unstructured P.T. program, but set goals ___

256. Structured P.T. program ___

257. Provide instruction on Yoga techniques ___

258. Issue weights that can be attached to ankles while walking ___

259. Require students to double time in Bell Hall ___

260. Mandatory P.T. program for first two months, daily dozen plus run three times per week before class ___

261. More realistic standards that are enforced ___

262. Make P.T. fun ___

263. One day per week mandatory P.T. with all offices closed ___

264. Make the attainment of fitness standards a criterion for promotion ___

265. Physical exercises/movement during lectures/classes - e.g. arm and leg exercises ___

266. Airborne example - if a student cannot answer questions in class, have him/her do 20 push-ups ___

267. Each student medically evaluated and told, as applicable, that P.T. is needed ___

268. Double time when outside the building ___

269. Daily P.T. program with adequate clean-up time ___

270. Establish different stations for each exercise, e.g. sit-ups, chin-ups, etc. ___

271. After pre-test, tailor P.T. program to individual requirements ___

272. Daily formation at 1530 with P.T. until 1700 HRS, mandatory ___

273. Vary the P.T. program ___

274. Training schedule reflect one hour of P.T. per day ___

275. Daily P.T. enforced by sign-out roster showing where student is going ___

276. Establish conditioning (obstacle) courses (3 levels of difficulty) ___

277. Construct bicycle paths ___

278. Construct additional tennis courts ___

279. Improve the gym facilities ___

280. Establish health spa type facility in basement of Bell Hall ___

281. Put a pull-up bar in each section ___

282. Need areas where sports can be played on an ad hoc basis - more fields ___

283. Construct an indoor track ___

284. Construct larger indoor pool ___

285. Equipment for isometrics ___

286. Establish indoor facilities such as inflatable buildings to cover tracks ___

287. Construct sports complex - handball, racquet ball, tennis ___

288. Scales in Bell Hall to check weight ___

289. Mirrors in Bell Hall (weight control)

290. Construct sauna in recreational facilities for use after work-out ___

291. Establish massage facilities for use after workout ___

292. Make sure gyms are used to full capacity ___

293. Adjust hours of operation in gyms if necessary (open longer e.g.) ___

294. Make sure activities available in gym meet requirements of P.T. program ___

295. Ping pong tables in the hallways ___

296. Build another gym close to Bell Hall ___

297. Turn the quadrangle near the library into an exercise area ___

298. Set up housing block P.T. program ___

299. Set up housing block athletic program ___

300. Shower facilities in Bell Hall ___

301. Locate facilities within or adjacent to student housing areas ___

302. Sauna in Bell Hall ___

303. Steam room in Bell Hall ___

304. Increase sport facilities ___

305. Chin-up bars and rope climb in housing area ___

306. Lay out jogging routes that are not in the streets ___

307. Construct ¼-mile track in vicinity of housing area ___

308. Provide more equipment in the gyms ___

309. Weight training facilities in Bell Hall ___

310. Convert the golf course (refuge for overweights) into cross country obstacle course ___

311. Make facilities available to families at specified times ___

312. Measured bicycle courses ___

313. Increase locker facilities in gyms ___

314. Keep gyms open 24-hours a day ___

315. Sidewalks from all housing areas to Bell Hall ___

316. Improve sports facilities ___

317. Establish health club in Bell Hall ___

318. Sit-up boards in classrooms ___

319. Facilitate running ___

320. Facilitate swimming ___

321. Install exercise devices throughout the school (ropes on pulleys with weights, chin-up bars)

322. Construct outdoor handball courts ___

323. Construct more handball courts ___

324. Lighted jogging area ___

325. Publish gym hours in daily bulletin ___

326. Open gym before school hours ___

327. Increase space available for indoor activities ___

328. Establish areas on post that are accessible only by walking ___

329. Construct swimming pool on west side of post ___

330. Provide more hiking and nature trails ___

331. Construct combination indoor pool and track ___

332. Set up an indoor obstacle course ___

333. Construct track and field house for 1,000 students - include basketball and volleyball courts ___

334. More and better sports equipment availability ___

335. Close gas stations (tied to suggestion to issue bicycles) ___

336. Give wives reduced priority in gyms ___

337. Improve squash facilities ___

338. Improve track facilities ___

339. Construct indoor pool in Bell Hall ___

340. Place rungs (like pull-up bars) in halls so students must use them to enter or leave a classroom ___

341. Build horseback riding facility ___

342. Have building projects, such as renovation of buildings by student sections ___

343. Build bike trails ___

344. Improve shower facilities ___

345. Convert some squash courts to handball courts ___

346. Bicycle route to Bell Hall ___

347. Roller skating rink in summer ___

348. Ice skating rink in winter ___

349. Fire department could place water on parking lot in winter to make ice skating rink ___

350. More time at athletic facilities for C&GSC students exclusively ___

351. More jogging lanes ___

352. Jogging lanes which provide more variety ___

353. Designate a gym for indoor track during inclement weather ___

354. Keep outdoor track free of snow ___

355. Install whirlpool in gym ___

356. P.X. accept bids for a health spa ___

357. Monthly class ___

358. Central eating facility ___

359. Priority of indoor pool to students ___

360. Ban use of gym for nonmilitary ___

361. Athletic facilities in Bell Hall ___

362. Turn Eisenhower Auditorium into a gym ___

363. Require students to rearrange tables instead of classroom service personnel ___

364. More marked areas for measured mile running ___

365. More swimming pools ___

366. Cross country skiing ___

367. Orienteering - running ___

368. Orienteering - walking ___

369. Orienteering - cross country skiing ___

370. Timed golf rounds (carry full set of clubs, run between holes) ___

371. Cross country competition ___

372. Water ski on river for endurance ___

373. C&GSC track and field team ___

374. Swim teams - intersection competition ___

375. Special participation programs from off post, e.g. Boston Marathon ___

376. Add cycling to the P.T. program ___

377. Add boxing to scheduled P.T. ___

378. Add racquetball to scheduled P.T. ___

379. Add handball to scheduled P.T. ___

380. Add tennis to scheduled P.T. ___

381. Add canoeing to scheduled P.T. ___

382. Bowling as scheduled P.T. ___

383. Golf as scheduled P.T. ___

384. Gymnastics as scheduled P.T. ___

385. Require mandatory minimum of five students from each section in spring orienteering ___

386. Add indoor track events to sports program (winter) ___

387. Include bowling as a recognized sport ___

388. Weekend orienteering competition ___

389. Teach water safety classes for nonswimmers ___

390. Add swimming to P.T. program (sustained activity) ___

391. Orienteering mandatory for all students with intersection competition ___

392. Long distance running competition (mini-marathon)

393. Play active sports all year ___

394. Each student must sign-out for a sport for one hour per day ___

395. Investigate Air Force point system - C&GSC system not equitable ___

396. Fitness records checked by someone other than students themselves ___

397. Personal fitness program for overweight individual - not ridiculed when progress checked ___

398. Flexible system so all can participate, program for fat and skinny ___

399. Start program where students are and work up to desired level ___

400. Group fitness session at beginning of year - establishing a good fitness program ___

401. More emphasis on P.T. program and participation ___

402. Students counseled by fellow students on ways or methods to improve programs ___

403. Upper and lower body weight program ___

404. P.T. goals established by individual should be met and reflected on academic report ___

405. Establish individual P.T. goals ___

406. Series of expert lectures ___

407. Restrict school to five hours per day and one hour of P.T. ___

408. Show TV tapes of body building activities ___

409. Issue the Canadian Air Force book on P.T. ___

410. Teach the P.T. prescribed in Army Field Manuals ___

411. Run two miles four times per week ___

412. Treat like adults - establish standards ___

413. P.T. instead of social functions ___

414. Free gym clothes ___

415. P.T. sessions each morning ___

416. No walking on post - only jogging ___

417. Family must participate in P.T. ___

418. 50 pushups in each 10-minute break ___

419. Daily check on each student's personal P.T. ___

420. Program with definite guidance ___

421. More comprehensive program - upper as well as lower body ___

422. Leave it up to individual to decide if he is in gook shape when he leaves ___

423. Organized P.T. led by General Officers ___

424. Section set criteria for a standard - peer pressure to maintain standard ___

425. Mandatory 7-mile marathon - wives participate ___

426. Reduce emphasis on physical fitness ___

427. Test at frequent intervals ___

428. Choice of type of test (e.g. jogging, swimming) ___

429. Establish minimum standards ___

430. Initial diagnostic test ___

431. PCPT at frequent intervals ___

432. More stringent P.T. test (raise standards) ___

433. Must pass P.T. test before attending C&GSC (prerequisite) ___

434. Unannounced spot tests ___

435. Must pass minimum standard to graduate ___

436. P.T. tests not just running (aerobics) tests ___

437. Conduct test before graduation to compare ___

438. Verify that specifically established standards are met by testing ___

439. MOS related to P.T. test ___

440. Remove students who do not meet minimum standards ___

441. Weekly test for those not fit (e.g. 1½-mile run/week until standard is met) ___

442. Establish minimum standard throughout the Army ___

443. Go-no-go P.T. test - all events ___

444. P.T. test as currently conducted administered at start of year ___

445. Evaluate every two weeks ___

446. More challenging P.T. tests ___

447. Tests for specific aspects of fitness - abdominals, legs, etc. ___

448. Increase standards on Army-wide P.T. test ___

449. Minimum standards should become increasingly higher throughout the year ___

450. Conduct 1½-mile run for each section once a month (2-3-mile voluntary alternative) ___

451. Only assign officers who meet certain physical standards to the desired combat jobs (division or corps) ___

452. Severe sanction for failure to pass P.T. test - Article 15 ___

453. Conduct monthly P.T. test with increasingly more difficlt standards ___

454. Evaluate group P.T. ____

455. Evaluate individual P.T. ___

456. Standards on 1½-mile run upgraded - everyone must complete in 13 minutes ___

457. Eliminate "no P.T. test for over 40's" ___

458. Higher fitness goals - e.g. every graduate must run five miles in 50 minutes ___

459. Eliminate one time endurance test (1½-mile run, one time) ___

460. Establish standards based upon branch ___

461. Fitness requirement for handicapped ___

462. Fitness tests on a pass - fail basis ___

463. Remedial P.T. test for unsatisfactory performance ___

464. Publish P.T. test results by name ___

465. Give P.T. test first day of class - those who fail do not attend C&GSC ___

466. Students run accurately graded indoor obstacle course ___

467. Students set their own goals to achieve on the indoor obstacle course ___

468. Have 1-mile run test as alternative ___

469. Have an endurance run as a test alternative ___

470. Different test for troop and staff jobs ___

471. 10-minute timed test of exercises using all body muscles - improve from period to period ___

472. Weekly test for students who opt not to participate in sports ___

473. Test Friday noon, those that meet standards go home, those that fail take remedial P.T. ___

474. Test after two months of mandatory P.T.; pass - voluntary sports; fail - more P.T. ___

475. Walking test ___

476. Standards for different types of test must be according to age ___

477. Test every week with 25 or so different tests commensurate with

478. Use standard PCPT to test students ___

479. Fit P.T. standards to individual jobs ___

480. P.T. test during registration - P.T. required for those who fail to meet standards ___

481. All students demonstrate improvement each week ___

482. Fitness standards higher for C&GSC than for the rest of the Army ___

483. Examine whether fitness standards should be based on primary specialty or some other standard ___

484. Do not set standards too high - appropriate to needs of the individual ___

485. Research project to revise existing P.T. test for realism ___

486. Test all students - provide attention to the needy ___

487. Family P.T. tests ___

488. Reinstate regular P.T. test ___

489. First standard - be sure everyone participates ___

490. Do not penalize student for being late to class if he/she walked to school ___

491. Set aside classroom time for 10-15 minutes of isometrics each day ___

492. Divert recreational funds from nonphysical to physical activities ___

493. Teach relaxation and breathing techniques ___

494. Provide athletic clothing ___

495. Close the club system ___

496. Rotate classrooms so more people have a chance to climb stairs ___

497. Scheduled time for P.T. activities where entire section is involved ___

498. Develop a special program for cooperative degree students ___

499. Mandatory participation by cooperative degree students ___

500. Standard that fitness must improve before leaving C&GSC ___

501. P.T. must contribute to professional development of officers ___

502. General officers participate in P.T. with the students ___

503. Develop a calisthenics pamphlet for students ___

504. Fire Bob Miller ___

505. Class director expand number of articles he writes (physical

fitness) ___

506. Class director appear on TV ___

507. More spectator attendance at student sports activities ___

508. Integrate physical activities into the work day ___

509. Better variety and availability of athletic clothing in P.X. ___

510. Show TV tapes on sports during lunch ___

511. Periodic discussions/once a week seminars on ways to maintain fitness other than formal P.T. ___

512. Official photos in TW's instead of greens - more accurately shows a person's figure ___

513. Require fatigues to be worn as daily uniform ___

514. More visible participation in P.T. by staff and faculty ___

515. Charts in classroom showing isometric exercises that can be done during breaks ___

516. Relocate C&GSC to a warm climate - 365 days per year P.T. ___

517. Hire physical education teacher for the school ___

518. Fitness council with representatives from student body and faculty, report direct to commandant ___

519. Periodically require each section to walk 30 kilometers per day for each of two consecutive days ___

520. Teach unarmed combat, e.g. Judo ___

521. Encourage (promote) use of bicycles ___

522. Place signs throughout building publicizing physical fitness ___

523. Open the windows in Bell Hall ___

524. Fire all fat faculty members ___

525. Mandatory physical education training course part of core curriculum ___

526. Hold some classes outdoors as weather permits ___

527. Establish physical fitness department in the P.X. - weights, exercise cycles, etc. ___

528. Have C&GSC buy exercise equipment for student use ___

529. Use peer pressure - organized work group programs ___

530. Publicize availability of facilities ___

531. Publicize what can be done at various facilities ___

532. Staff/cadre participate with students, includes commandant ___

533. Modify school year to more evenly distribute academic load - result in more time during first term ___

534. Encourage walking - tie-in with energy conservation program ___

535. Lease bicycles ___

536. Eliminate parking lots ___

537. Develop daily P.T. "menu" for new sports ___

538. Well publicized jogging routes ___

539. Teach unarmed combat, Tai kwando

540. P.T. time on training schedule must be used for P.T. - not study ___

541. Make training more interesting - more people ___

542. Realistic P.T. standards reflected on student OER ___

543. More management of the P.T. program on part of class director's office - not just paper work ___

544. Recreational Services sponsor ski/sled trips ___

545. Recreational Services sponsor skating trips ___

546. Recreational Services sponsor trips involving individual physical participation ___

547. More command emphasis ___

548. Mandatory participation by faculty ___

549. Realistic class schedule where homework requirements go along with P.T. program ___

550. Image of whole post one of fitness - not just the college, no exceptions ___

551. Ride bicycles to class (or run) ___

552. Make physical fitness a part of academic report ___

553. Father/son, mother/daughter competitions ___

554. Dancing (bump) scheduled as P.T. ___

555. Give sports coordinators elective credit ___

556. Required courses on the benefits of physical fitness ___

557. Lectures by professional team coaches ___

558. Maintain a reading list on fitness ___

559. Devise physical activities for those who are not jocks ___

560. Threaten ___

561. Full-time faculty member for P.T. activities ___

562. Sports program with different levels of confidence ___

563. Educate wives to support husband and participate with him ___

564. Require students to carry all issue material to class ___

565. Questionnaire to determine desirable activities ___

566. No soft chairs ___

567. Require daily reading of Anne Landers ___

568. Students conduct post police ___

569. No seats in auditorium ___

570. All fatsos in one section ___

571. All jocks in one section ___

572. Climb stairs three at a time ___

573. Have visiting speakers lead P.T. during stretch breaks ___

574. Rappeling off of Bell Hall ___

575. Require all to lose one inch from waist ___

576. Set example - school send recommendation to get rid of overweight members of DA Staff ___

577. Encourage hiking as part of classes where appropriate ___

578. Two pictures in file - one formal and one in gym shorts ___

579. Football club ___

580. Riding club ___

581. Basketball club ___

582. Family physical activity on a competitive basis ___

583. Family mini olympics ___

584. DA selection board select only physically fit personnel for attendance at C&GSC ___

585. Use team and individual sports as means of evaluating participation ___

586. Use team and individual sports as means of determining fitness ___

587. Enroll students in sports based on needs ___

588. Increase emphasis on group sports such as soccer and football ___

589. Combat football ___

590. 10 to 15-man raft races - work group ___

591. Go to Air Force system of traveling teams in Army areas ___

592. Shorten sports season - force students into more sports ___

593. Introduce new sports and activities not now used ___

594. Limit number of participants on any one team (i.e. 13 soccer players) ___

595. Mandatory participation in sports ___

596. Less violent athletic program ___

597. Better supervision of exercise program ___

598. Organized sports during workday hours ___

599. Formation runs - mandatory - increasing distance (e.g. section) ___

600. Student teams compete with dependent teams ___

601. Require each officer to participate in at least two team and two individual sports ___

602. Add track and field sports to the intramural program ___

603. Develop list of sports geared to student age bracket ___

604. Team handball ___

605. Basketball as scheduled P.T. ___

606. Football as scheduled P.T. ___

607. Volleyball as scheduled P.T. ___

608. Family volleyball ___

609. Family softball ___

610. Family running relays ___

611. Athletic program like public schools - i.e. all participate in football during fall etc. ___

612. P.T. in social life - pool party ___

613. Have volleyball party to include P.T. in social life ___

614. Expand current program to allow substitutes to play rather than sit on the bench ___

615. Require each student to play at least one of the following in spring: orienteering; soccer; baseball ___

616. Water polo ___

617. Flicker ball league in spring ___

618. Father/son soccer teams in spring ___

619. Schedule competitive sports in POI at least three times per week ___

620. School support sports program - do not schedule classes during scheduled sports ___

621. Require participation in at least two team sports ___

622. Require substitution every five minutes making it mandatory for each member to play ___

623. Add indoor soccer to sports program (winter) ___

624. Concentration on participation in team sports rather than on winning ___

625. Intersectional pushball ___

626. Lesser capable athletes compete during specified portions of games - e.g. second and fourth quarters ___

627. Increase number of teams allowed in organized sports per section ___

628. Provide section points for number of participants (in addition to "winner" points) ____

629. Eliminate organized athletics ___

630. Require participation in at least three sports per year ___

631. Participate in a sport at least three times per week with test twice a year ___

632. Deemphasize sports where only a few can participate ___

633. Establish a physical size level for all sports ___

634. Provide referees from Special Services - safety and control ___

635. Every member of a team must play at least two quarters ___

636. Mixed sport programs - male and female ___

637. Restrict driving on post to certain hours ___

638. Instructions and fields for instruction in sports without large participation ___

639. Develop a structure of levels of sports - better athletes in one league, others in another league ___

640. Promote low profile sports - increase visibility of participants ___

641. Reestablish big time sports at Army level - morale and incentive ___

642. Publicize new sports ___

643. Encourage new sports to increase participation ___

644. Develop curriculum to support sports ___

645. Support a semipro football team ___

646. Sports for wives ___

647. "Almost Anything Goes" type games between sections ___

648. POI include introduction to new sports ___

649. More creative team athletics ___

650. Weight control program ___

651. Inspection of sections by class director to see who is flabby ___

652. Public chastisement of overweight/flabby persons ___

653. Mandatory weigh-in each Monday for all personnel (or biweekly, or monthly) ___

654. Monitor fitness progress by keeping record of pulse rate, blood pressure, weight, etc. ___

655. Physical exam (determine condition prior to P.T.) ___

656. Rigid physical exam to identify individuals needing help (include treadmill) ___

657. Program preceding exercise program to explain physiological, ana-

tomical, etc. aspects of sports ___

658. Class on health factors such as diet and sleep ___

659. Post weight loss progress on bulletin board ___

660. Periodic weight checks for students a doctor determines to be overweight ___

661. Conduct smoking clinics ___

662. A dispensary in Bell Hall - E6 medic and nurse ___

663. Mandatory nutritional requirements (e.g, vitamins) ___

664. Post weight charts in Bell Hall ___

665. Post appropriate signs to instill initiative to lose weight ___

666. Personal program for overweight individuals ___

667. Use before and after photos ___

668. Special program for students with medical profile - doctor directed ___

669. Serve only diet foods in snack bar (attractive, yet low calorie) ___

670. Close the snack bar ___

671. Eliminate candy machines and hot chocolate ___

672. Only diet drinks in soda machines ___

673. Eliminate lunch breaks ___

674. Eliminate smoking ___

675. Remove drink machines from halls ___

676. Formal lecture about obesity and its consequences ___

677. Offer dietary meals in the school cafeteria ___

678. Get the medical staff involved ___

679. Provide diet counseling at the school ___

680. Eliminate coffee ___

681. More stringent weight standards ___

682. Make smoking illegal ___

683. Overweight clinic ___

684. Do not sell candy anywhere in school including cafeteria ___

685. Eliminate greasy, fattening foods from the cafeteria ___

686. Severe sanctions for overweight - Article 15 ___

687. Public information campaign - health implications of smoking ___

688. Public information campaign - health implications of excessive drinking ___

689. Public information campaign - health implications of sedentary habits ___

690. Medical advice for weight control without a hassle ___

691. Provide special diets for weight loss through hospital (i.e. high protein liquids) ___

692. Recognize that weight and fitness (ability to run) do not necessarily correlate directly ___

693. Mandatory diet for those overweight ___

694. Mandatory diet for those not physically fit ___

695. Health foods in commissary ___

696. Nutrition ___

697. Life style ___

698. Eliminate (reduce) drinking ___

699. Enforce no smoking policies ___

700. Learn relaxation techniques - e.g., TM ___

701. Instead of smoke break, do sit-ups, pull-ups, etc. ___

702. Publish recommended calorie intake or diets for different heights and weights ___

703. Provide diet information and concrete guidance on meal planning and nutrition to student wives ___

704. Install fruit vending machines in Bell Hall ___

705. Install milk, vegetable, and soup vending machines ___

706. Prizes for weight loss ___

707. MD's put on "road show" boosting health aspects of fitness ___

708. Put up "THINK" signs on the doughnut counter ___

709. Class on importance of cardiac and pulmonary system ___

710. Curriculum classes on physiology ___

711. Information on benefits of proper diet ___

712. No doughnut dispensers in Bell Hall ___

713. Medical test monthly or bimonthly to monitor progress ___

714. Emphasize weight control and aerobics as key to physical fitness ___

715. Medical stress test to determine endurance ___

716. Conduct classes/training/discussion on nutrition ___

717. Hire nutrition teacher for the college ___

718. Charts to show energy requirements of human body posted in classrooms ___

719. Charts to show the value of proper diet posted in classrooms ___

720. Screen students to determine who is overweight (initial weigh-in) ___

721. Give each individual a weight goal to work toward ___

722. Professional instruction on proper diet ___

723. Establish milestone schedules for loss of weight ___

724. Mess hall and commissary should publish lists of calorie information ___

725. MSC periodically check weight against milestones ___

726. Obese person excused from P.T. program only by doctor for medical reasons ___

727. Better menu planning in dining facility ___

728. Group fitness sessions at beginning of year - diet and weight ___

729. Weight watchers club ___

730. Stop sale of beer during lunch ___

731. Stop sale of booze on post ___

732. Officer's club operate health spa ___

733. Have a qualified masseuse ___

734. Sell only diet foods in commissary and PX ___

735. Ban smoking in Bell Hall ___

736. Ban lunch ___

737. Stop selling candy and doughnuts in PX and snack bars ___

738. Classes for the overweight ___

739. Limit of one cup of coffee per day ___

740. Require hospital CO to become more involved ___

741. Officer corps put more emphasis on emotional rather than physical fitness ___

742. Define physical fitness ___

743. Award to student for best record in physical fitness (P.T. and sports) ___

744. Award to those exceeding established standards ___

745. Award for substantial improvement ___

746. Award additional leave for excellence in fitness ___

747. Reduce pay by amount of decreased effectiveness due to poor fitness ___

748. Provide rewards for fitness ___

749. Awards such as ribbons for meeting milestones on self administered tests ___

750. Team sports competition to increase interest in fitness ___

751. Conduct a mini decathlon ___

752. Establish a senior olympics - various events ___

753. Ski competition ___

754. Swimming competition (e.g., class tournament) ___

755. System of awards that allows those with weight problem to achieve (walk so many miles) ___

756. Track and field competition with other service schools, posts, etc. ___

757. A program using TV's "Super Stars" program ___

758. Section and workgroup competition in sports ___

759. Individual sports conpetition to increase interest in fitness ___

760. Division level athletic teams ___

761. Provide real incentives to winners of section events - trips, free tickets to sports events ___

762. Form teams to compete with local colleges ___

763. Punishment incentive for failure to meet minimum standard ___

764. Use incentives to increase the class average during year ___

765. Compare class average year to year; long term ___

766. Compare students to active Army on post, to college students, etc. ___

767. Conduct a biathlon ___

768. Conduct a triathlon ___

769. Competitive force march ___

770. Intersection obstacle course competition ___

771. Husband/wife handball/racquetball tournaments ___

772. Husband/wife tennis tournaments ___

773. Family sports competitions (whole families compete as team) ___

774. Eliminate competition between sections to encourage less skilled students to play ___

775. Provide awards for group efforts ___

776. Father/son long distance relay races ___

777. Competitive running between whole sections (all members must participate) ___

778. Monthly section run-offs to determine best "running" section ___

779. Award banner or trophy to the winner of section running competition ___

780. Competitive running between sections - winner based on most participants and best time ___

781. Give award for running 500 and 1,000 miles ___

782. Competition by branch or OPMS specialty instead of by section ___

783. Faculty versus students events ___

784. Organize wives teams to play against student teams ___

785. Offer incentive such as cuts from core curriculum classes for high degree of fitness ___

786. Officer pro-pay for exemplary fitness ___

787. Section outings for family participation competitions, mandatory ___

788. Section outings for family participation competitions, reward for 100 per cent participation ___

789. Interpost competitions held at Fort Leavenworth ___

790. All members of section participate in every sport - no intersection competition ___

791. Program of total involvement by family - award points for participation (i.e., fastest team) ___

792. Off-post competition Army or service wide ___

793. Inter-school competition with other service schools ___

794. Compete against area colleges in individual sports ___

795. Provide cash rewards for fitness ___

796. Assess cash penalties for failure to meet fitness standards ___

797. Competition in P.T. ___

798. Competition in athletics ___

799. Incentives (positive motivators) ___

800. Sponsor athletes for civilian competition ___

801. Recognition (sense of achievement) ___

802. Student awards ___

803. Cross-country runs by workgroup ___

804. Promote challenge matches versus CG or staff ___

805. Conduct tournaments more frequently ___

806. Recognize sports "stars" in the class ___

807. Have field days ___

808. Approve physical fitness badge for uniform ___

809. Give an hour of class time off for each 50 miles of running ___

810. Strong sanctions for failure to participate ___

811. Strong sanctions for mediocre performance ___

812. Local distinctive badges ___

813. Challenge matches against off-post teams ___

814. Challenge standards of other service schools ___

815. Provide days off for high performance on P.T. test ___

816. Competitive games like telephone pole pick-up between work-groups and sections ___

817. Award patch from CG in recognition of success (similar to Presidential Program) ___

818. DA or C&GSC award for attainment of certain levels of fitness ___

819. Sponsor sportsarama - individual contests and prizes ___

820. Sponsor sportsarama - team competitions ___

821. Sponsor a decathlon ___

822. Daily competition ___

823. Allow student to leave C&GSC one month early for score of 450 or over on P.T. test ___

824. Money for winning teams ___

825. Wives competitions ___

826. Weight loss competitions ___

827. Take away days of leave for substandard performance ___

828. Reward for most improved student ___

829. Father/son, mother/daughter competition ___

APPENDIX B

INSTRUCTIONS TO JUDGES

The attached Master List is a listing of the ideas generated by C&GSC students in response to the question, "How can we improve the physical fitness of C&GSC students?"

The ideas were generated by individuals working alone and by members of 5-man groups as part of an experiment designed to test the efficacy of group brainstorming. In short, the experiment compares the mean number of ideas generated by 5-man nominal groups (groups in name only, the individuals worked by themselves and their ideas were later pooled to form a "group" total) to the mean number of ideas generated by 5-man operational groups (groups consisting of five members brainstorming the problem in face-to-face interaction).

Brainstorming is a technique designed to foster ideation. The basic rules of brainstorming which the students were instructed to follow as closely as possible are as follows: (1) Do not criticize or judge ideas; (2) Wild ideas are desired; (3) Look for combinations; (4) Quantity is the goal. The underlying assumption is that the greater the quantity of ideas generated, the more good ideas will be created. Some of the ideas that you will evaluate will seem very similar to other ideas; however, in the opinion of the author there is sufficient difference among the ideas to warrant their inclusion as separate ideas on the master list. In some cases the difference is very slight; nevertheless, even a very slight difference may make the difference between a good idea and a relatively common idea. The evaluation is strictly up to your judgement. If several ideas seem to be essentially the same, do not hesitate to give them the same evaluation.

Please evaluate each of the ideas on the master list by placing a letter in the blank space at the end of the idea that corresponds to one

of the following categories:

P - a poor idea that does not merit further consideration because it would not improve physical fitness or would be totally impractical to implement.

A - an acceptable idea in that it might improve physical fitness and at least has some possibility of implementation, however slight. In other words, an idea that is at least worthy of some consideration.

G - a good idea that either shows innovation with some possibility of implementation or a less creative idea, but one that can easily be implemented.

Please read the categories very carefully several times before evaluating the ideas on the master list. Remember, the evaluation is strictly your subjective evaluation. Nothing should be implied about the number of ideas that should be placed in any category. It is possible that you will evaluate all ideas as acceptable with neither good nor poor ideas categorized. On the other hand, you may determine that the list contains a mix of all of the categories. Thank you for taking the time to assist in the evaluation of these ideas. Your evaluation will be compared to the evaluation of two other judges in order to arrive at the final categorization of the ideas.

The final results of the experiment will be available for your perusal if you are interested. Again, I thank you for your assistance.

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